To what extent does the interest burden affect firm survival? Evidence from a panel of UK firms during the recent financial crisis

Guariglia, Alessandra; Spaliara, M.-E.; Tsoukas, S.

DOI:
10.1111/obes.12120

Document Version
Early version, also known as pre-print

Citation for published version (Harvard):
Guariglia, A, Spaliara, M-E & Tsoukas, S 2015, 'To what extent does the interest burden affect firm survival? Evidence from a panel of UK firms during the recent financial crisis', *Oxford Bulletin of Economics and Statistics*, vol. 78, no. 4, pp. 576-594. https://doi.org/10.1111/obes.12120

Oxford Bulletin of Economics and Statistics
Published on behalf of the University of Oxford's Department of Economics

To what extent does the interest burden affect firm survival? Evidence from a panel of UK firms during the recent financial crisis

Journal:	*Oxford Bulletin of Economics and Statistics*
Manuscript ID	OBES-12-235.R4
Manuscript Type:	Original Article

To what Extent Does the Interest Burden Affect Firm Survival? Evidence from a Panel of UK Firms during the Recent Financial Crisis*

ALESSANDRA GUARIGLIA[+], MARINA-ELIZA SPALIARA[++], AND SERAFEIM TSOUKAS[++]

[+] *Department of Economics, University of Birmingham, Edgbaston,* Birmingham, B15 2TT*, UK. (e-mail: a.guariglia@bham.ac.uk)*
[++, +++] *Department of Economics, Adam Smith Business School, Gilbert Scott Building, University of Glasgow, Glasgow, G12 8QQ, UK. (e-mail: serafeim.tsoukas@glasgow.ac.uk, marina.spaliara@glasgow.ac.uk)*

Abstract

Using a panel of mainly unquoted UK firms over the period 2000-09, we document a significant effect of changes in the interest burden from debt-servicing on firm survival. The effect is found to be stronger during the recent financial crisis compared with more tranquil periods. Furthermore, the survival chances of bank-dependent, younger, and non-exporting firms are most affected by changes in the interest burden, especially during the crisis. Our results are robust to using different estimation methods and different interest burden measures. They suggest that one way for policymakers to mitigate the effects of financial crises by limiting firm failures would be to prevent financing costs from rising, especially for those firms more likely to face liquidity constraints.

(Word count: 8,746+ 3 tables= 10, 246)

* JEL Classification numbers: D21; E22; E32; G31.
We thank the Editor and two anonymous referees for very helpful comments and suggestions. We are also grateful to Markus Eberhardt, Richard Harris, Kishore Kamath, Stephen Millard, Daphne Nicolitsas, George Panos and Evan Wohlmann for useful comments, as well as to participants at seminars at the Bank of England, the Bank of Greece, the Universities of Glasgow, Leicester, Patras, and Stirling, and at the 2012 European Association for Research in Industrial Economics meetings, the 2013 European Meetings of the Econometric Society, and the 2013 Royal Economic Society conference. The first and second authors gratefully acknowledge financial support from the British Academy. Any remaining errors are our own.

I. Introduction

In August 2007, an irregular pattern of financial difficulties became a fully-fledged financial crisis involving most of the world's largest banks (see Goodhart, 2008, for a survey). These events had a strong impact on UK financial markets in general and the banking sector in particular. Due to the turmoil in financial markets, at the end of the third quarter of 2008, 1.4 million small firms in the UK reported a severe shortage of credit, and some 30% of firms considered shutting down their operations altogether unless credit became cheaper and more easily available (Kirkup and Tyler, 2008)[1]. In addition, according to the Federation of Small Businesses, almost 30,000 small and medium-sized enterprises (SMEs) failed in 2009, while figures provided by the Office for National Statistics (2010) show that the corporate death rate in the UK at the end of 2009 was 11.8%. Paying special attention to England and Wales during the early 1990s recession and the current financial crisis, Benito et al. (2010) confirm that company liquidations rise during recessionary periods. This evidence suggests the presence of a strong link between the shortage and high cost of credit, which typically characterizes recessions, and firm failures.

The purpose of this paper is to further investigate the effects of the recent financial crisis on firms' survival chances. To this end, we focus on the impact of changes in a firm-specific interest rate (which we call interest burden and define as the ratio of a firm's total interest payments to cash flow) on business failures in the UK over the period 2000-2009, and assess whether the strength of this impact increased during the crisis years.

Our study is motivated by the financial accelerator-related hypothesis according to which deteriorations in economic conditions increase the cost of finance, which in turn

[1] Similarly, according to the British Chambers of Commerce (BCC), one third of small and medium-sized businesses in the UK faced difficulties in accessing finance during the recent crisis. Even more recently, access to finance remains a "major barrier" to growth for more than one in five small companies, with 41% of loan applications refused in the three months to February 2012 (Kuchler, 2012).

weakens firms' balance sheet positions, thus influencing their ability to borrow, and, consequently, their activities and survival chances (Bernanke et al., 1996; Perez-Quiros and Timmermann, 2000; Vermeulen, 2002). It is well accepted that firms' interest burden is inversely related to their balance sheet positions. A high interest burden can in fact be seen as evidence that the firm is charged a high external finance premium. The countercyclical movement in the premium for external funds amplifies borrowers' spending and economic activity through the financial accelerator (Bernanke et al., 1996). Thus, the debt servicing cost is expected to affect firms' real and financial decisions, as well as their survival prospects.

The present study makes two important contributions to the literature. First, while previous papers have included balance sheet variables in equations modeling firm survival (Bunn and Redwood, 2003; Bridges and Guariglia, 2008), the literature is silent on the role of the firm-specific interest burden in determining firms' chances of failure. Considering the evidence according to which higher levels of interest payments negatively affect fixed investment and employment decisions at the firm-level (Nickell and Nicolitsas, 1999; Benito, 2005; and Benito and Young, 2007), we move this literature forward by investigating, for the first time, the links between firms' interest burden and their survival chances. As firms' real activities are adversely affected by a rise in borrowing costs, we expect higher levels of the interest burden to be associated with lower chances of firm survival. Moreover, we differentiate the effects of changes in the interest burden on firm survival over a tranquil period (2000-2006) and the financial crisis period (2007-2009), focusing on the UK, which was particularly affected by the crisis (Rose and Spiegel, 2011). This may help us understand the channels through which the financial crisis led to the failure of several UK firms, and in particular several small and medium-sized enterprises (SMEs).

Our second contribution is that contrary to most of the literature, which looked at the effects of the financial crisis focusing on listed companies (e.g. Kahle and Stultz, 2013; Santos, 2013), we focus on a large panel of mainly unlisted firms. As unlisted companies are typically younger and smaller than their listed counterparts, they are more likely to face problems of asymmetric information, and are hence more likely to be affected by liquidity constraints (Hughes, 1994). Focusing on unlisted companies allows us therefore to provide a sharper analysis of the effects of the recent financial crisis on corporate behavior than previously done in the literature.

In addition, the size of our panel enables us to take into account three dimensions of firm heterogeneity (bank dependency, age, and export status), aimed at measuring the degree of financing constraints faced by firms. This is an important contribution in the light of the fact that the firms in our sample are heterogeneous and unlikely to be affected by changes in the interest burden in the same way. Our first dimension of firm heterogeneity is based on the extent to which firms can be considered as bank-dependent. It is now well documented that since the onset of the crisis, banks have incurred severe losses, which have led them to significantly increase the cost of loans directed towards bank-dependent firms (Santos, 2013). Also considering that the pool of funds that banks could lend was reduced during the crisis (Ivashina and Scharfstein, 2010), this suggests that bank-dependent firms are likely to have suffered more from the effects of the crisis than their less bank-dependent counterparts. Next, we differentiate old from young firms, whereby the latter are likely to face a higher degree of information asymmetries due to the lack of track record reputation, and hence a higher degree of financing constraints (Hadlock and Pierce, 2010). Finally, we distinguish exporters from non-exporters, whereby the former are less likely to face financing constraints (Greenaway et al., 2007). We expect

bank-dependent, younger, and non-exporting firms' failure probabilities to be most affected by changes in the interest burden, especially during the crisis years.

We find that the interest burden has a significant effect on firm survival, and that this effect is stronger during the recent financial crisis compared with more tranquil periods. Furthermore, the survival chances of bank-dependent, younger, and non-exporting firms are most affected by changes in the interest burden, especially during the crisis. Our results are robust to using different estimation methods and different interest burden measures.

The remainder of the paper is organized as follows. Section II provides some economic background for our research. In section III, we illustrate our empirical specifications and the main hypotheses that we test. Section IV describes our data and presents some summary statistics. Section V illustrates our main empirical results. Section VI provides some robustness tests, and Section VII concludes and discusses some policy implications.

II. Economic background

In a world characterized by asymmetric information between borrowers and lenders, there exists a wedge between the cost of funds generated externally (by issuing debt or equity) and internally (by retained earnings, Bernanke and Gertler, 1995; Bernanke et al., 1996). As general interest rates (and hence the interest burden) rise, firms' net worth is reduced[2], and their balance sheet situation worsens. Due to moral hazard and adverse selection problems, this reduces lending to firms through the balance sheet channel (Bernanke and Gertler, 1995). This happens because banks reduce their actual lending to firms and/or because they charge rates so high that the borrowers can no longer afford to take up the

[2] Net worth comprises the firm's liquid assets and marketable securities. This includes cash flow. A rise in interest rates lowers cash flow, which, in turn, leads to a lower net worth.

loans. The upshot is that due to this reduced access to external finance, firms' investment and other corporate activities decline, which in the extreme, may lead to a rising probability of bankruptcy (Nickell and Nicolitsas, 1999). Small and young firms, and more in general, firms more likely to suffer from asymmetric information problems and financing constraints, will be most affected by this channel, as banks are always more reluctant to lend to them, and because they typically suffer from a higher wedge between the cost of external and internal funds.

This problem is likely to be exacerbated during periods of recession, which are characterized by sustained increases in the cost of external finance, independent on any monetary policy shift, through the financial accelerator (Bernanke et al., 1996). As the quality of borrowers deteriorates, which is typical during recessionary periods, lenders require in fact a higher spread to compensate them for the increased risk of lending (Santos and Winton, 2008). Being typically more risky, financially constrained firms are most likely to be charged even higher interest rates. This negatively affects their net worth, and provokes, in turn, a further reduction in their ability to borrow, further reducing their spending, investment, and production, raising their probability of bankruptcy, and magnifying the effects of the recession. Perez-Quiros and Timmermann (2000) propose a similar argument and further claim that because small firms, which are typically considered as financially constrained, are likely to be bank-dependent, they are also likely to be affected by the fact that under tighter credit conditions, the pool of funds that banks can lend out is reduced.

The international evidence on the recent financial crisis is indicative of a rise in the cost of credit and of a drop in firms' access to external finance. For instance, recent evidence shows that banks, and especially those which incurred the largest losses in connection with the subprime meltdown, monitored their borrowers more closely,

increased the cost of loans directed towards firms, and, more in general, became more cautious in their lending practices (Santos, 2013). Bank-dependent borrowers suffered more from this problem than borrowers with access to bond markets (Santos, 2013). Along similar lines, Ivashina and Scharfstein (2010) document a strong reduction in the supply of bank credit during the financial crisis, and Almeida et al. (2013) also note a significant drop in firms' access to external financing during the crisis, and claim this was a major determinant of firms' survival.

Focusing on the UK, the Bank of England reports a reduction of loans to private non-financial corporations (PNFCs) from UK monetary financial institutions during the financial crisis. Specifically, loans to PNFCs fell by £3.6 bn from 2007 to 2008, and by another £3.9 bn in 2009[3]. In addition, Bell and Young (2010) argue that the cost of credit rose sharply during the financial crisis, especially for SMEs. Yet, to the best of our knowledge, the extent to which this increase in the cost of credit has affected firms' survival chances in the UK context has not been investigated. Our paper fills this gap in the literature.

III. Empirical implementation

Baseline specification

In order to establish the extent to which financial pressure from debt-servicing costs affects firms' survival prospects, we model the determinants of firm survival and check whether the interest burden significantly affects it. In line with Bunn and Redwood (2003), Bridges and Guariglia (2008), and Helmers and Rogers (2010, 2011), we define a firm as failed in a given year when its status is that of receivership, liquidation, or dissolved.

[3] See the Bank of England Statistical Interactive Database (www.bankofengland.co.uk/mfsd/iadb).

Following recent literature on firm survival (Bandick and Görg and, 2010; Tsoukas, 2011; and Görg and Spaliara, 2014), our empirical models are estimated using the complementary log-log (cloglog) model, which is equivalent to the discrete time version of the Cox proportional hazard model[4]. The baseline proportional hazard is formulated as:

$$h(j, X) = 1 - \exp[-\exp(\beta' X + \gamma_j)] \quad (1)$$

where $h(j, X)$ is the interval hazard for the period between the beginning and the end of the j^{th} year after the first appearance of the firm. The β parameters show the effects of the explanatory variables X on the hazard rate, and γ captures period-specific effects on the hazard. To test whether firm exit is affected by the firm-specific interest rate, we include the interest burden (*IB*) among the explanatory variables.

The effects of changes in firm-specific interest payments on various aspects of firm behavior have been analyzed in previous literature. For instance, focusing on the UK, Nickell and Nicolitsas (1999) find that, controlling for expected wages and demand, an increase in the borrowing ratio (which they define as the ratio of interest payments to cash flow) has a large negative effect on firm-level employment. Benito (2005) shows that the same borrowing ratio is negatively related to firm-level inventory investment in both the UK and Spain; and Benito and Young (2007), that it also affects fixed investment, new equity issues, and dividend payments. Mojon et al. (2002) show that the mean interest on financial debt paid by small firms in the Euro area is on average higher than that paid by larger firms, and strongly affects firms' fixed investment. Benito and Whitley (2003) provide evidence of a significant inverse relationship between the financial health of UK firms and the firm-specific implicit interest rate, which they define as the ratio of interest payments to the moving average of three years of total debt centred at the current year.

[4] Our results were robust to using a pooled and random-effects probit model, as well as a linear probability model. The results, which are available upon request, remained largely unchanged.

Finally, recent evidence by Spaliara (2009) shows that the capital-labor ratio of financially constrained UK firms is more sensitive to the interest burden compared to that of their unconstrained counterparts.

Moving this literature forward, we employ the interest burden to capture, for the first time, the effects of a change in debt-servicing costs on firm survival. In the spirit of Nickell and Nicolitsas (1999), Benito (2005), and Benito and Young (2007), we measure the interest burden using the ratio of interest payments to cash flow. Increases in interest payments should negatively affect firms' financial position, therefore raising the interest burden. In turn, we expect higher levels of the interest burden to be associated with lower chances of firm survival.

In addition to the interest burden, the vector *X* comprises three additional financial variables aimed at capturing the effects of financial health on the likelihood of survival. These include solvency (*SOLV*), measured as the ratio of shareholders' funds to total assets; the leverage ratio (*LEV*), defined as the ratio of the firm's current liabilities to total assets; and the profitability ratio (*PROF*), defined as the ratio of earnings before interest and taxes to total assets[5]. The vecor *X* also includes the following additional firm-specific characteristics, which, according to the literature, affect firm survival: size (*SIZE*), measured as the logarithm of total real assets; age (*AGE*), defined as the difference between the present year and the firm's date of incorporation; and the dummy variable *GROUP*, which takes value one if the firm is part of a group, and zero otherwise. We also control for macroeconomic conditions by including the real effective exchange rate (*EXCHANGE*), calculated as the geometric weighted average of bilateral effective

[5] Contemporaneous values of the interest burden and our financial variables are included in our firm survival equation. Our results were robust to lagging these variables once to mitigate potential endogeneity concerns.

exchange rates adjusted by relative consumer prices. Lastly, *X* contains a set of industry and time dummies that control respectively for industry and business cycle effects[6].

Accounting for differences between crisis and non-crisis periods

In order to investigate the extent to which, controlling for other factors, firm survival differs in crisis years compared to more tranquil periods, we include in vector *X* of Equation (1) a financial crisis dummy (*CRISIS*), which takes value one over the period 2007-09, and zero otherwise[7]. The coefficient associated with the *CRISIS* dummy is aimed at capturing the marginal effect of the crisis on firm survival, holding everything else equal.

We next investigate whether in addition to having a direct effect on firms' chances of survival, the financial crisis may also have an indirect impact by magnifying the effect of firms' interest burden on survival. To this end, we examine whether the sensitivity of firms' survival prospects to changes in the interest burden differs between crisis and tranquil periods. Specifically, we include in the vector *X* of Equation (1) an interaction between the interest burden (*IB*) and the *CRISIS* dummy, and an interaction between the interest burden (*IB*) and the (1-*CRISIS*) dummy. Comparing the coefficients on these two interaction terms enables us to assess the extent to which changes in the interest burden have a different effect on firms' survival during tranquil and crisis periods. This test is motivated by the financial accelerator-related hypothesis according to which a deterioration of economic conditions negatively affects the health of firms' balance sheets. In these circumstances, firms facing increased debt-servicing costs might face a higher

[6] Section 1 in the online Appendix provides a thorough discussion of the effects that each of these variables is likely to have on firms' survival chances, in the light of the literature.
[7] Our results were robust to defining the dummy *CRISIS* equal to one in 2008-09, and 0 otherwise.

probability of failure during the crisis than outside. We therefore expect the effects of changes in the interest burden on firms' chances of failure to be stronger during the crisis.

Accounting for firm heterogeneity

We next explore the extent to which an increase in the interest burden may have a different impact on the survival chances of firms characterized by different degrees of financing constraints, taking into account the effect of the financial crisis. This test is motivated by Nickell and Nicolitsas (1999), who analyze the effects of changes in firms' borrowing ratio on their employment decisions, differentiating firms on the basis of the degree of financial pressure they face[8].

Following the literature (Kashyap et al., 1993; Huang, 2003; Guariglia and Mateut, 2006), we use bank dependency as our first indicator of the degree of financing constraints faced by firms. This can be justified in the light of the fact that it is generally risky and low credit firms, which rely on bank finance (Huang, 2003). As in Guariglia and Mateut (2006), we define bank-dependent firms in two ways: the first is based on their ratio of short–term debt to the sum of short-term debt and trade credit (*mix1*), and the second on their ratio of short-term debt to total current liabilities (*mix*2). Specifically, we create a dummy variable *BankDep1* (*BankDep*2) which is equal to one for firm *i* in year *t* if firm *i*'s *mix1* (*mix*2) falls in the top 50% of the distribution of the *mix1*s (*mix*2s) of all firms operating in the same industry as firm *i* in year *t*, and zero otherwise. As short-term debt is

[8] Nickell and Nicolitsas (1999) identify stronger effects of shifts in the borrowing ratio for companies which are under greater long-term financial pressure. They proxy long-term financial pressure using firm size, the dividend payout ratio, and the debt to capital ratio.

predominately made up of bank finance, the *BankDep1* and *BankDep2* dummies are good proxies of bank dependency.

We next partition our sample into young and old firms using the age of incorporation as a sorting device. We define a firm as young (old) in a given year if its age falls in the bottom (top) 50% of the age distribution of all firms operating in the same industry as this firm in that year, and 0 otherwise. Spaliara (2009) and Hadlock and Pierce (2010) note that young firms are less known and have not established a track record in the market. Consequently, they are more likely to be associated with a higher degree of informational asymmetry, and are less likely to have access to capital markets.

Finally, we differentiate firms between exporters and non-exporters, whereby the latter are firms that never exported throughout the sample period. It has been found that exporters are generally financially healthier than non-exporters (Greenaway et al., 2007; Guariglia and Mateut, 2010). This could be explained by three important considerations. First, exporters have access to both domestic and international financial markets, which enables them to diversify their sources of financing and the associated risks. Second, they are less tied to the domestic cycle, and less subject to those financial constraints induced by tight monetary policy and recessions at home.[9] They therefore benefit from a more stable cash flow, which, providing greater assurance to lenders that the firm will be able to service its obligation, relaxes their liquidity constraints (Guariglia and Mateut, 2010). Finally, given the presence of sunk costs that need to be met when entering foreign markets for the first time (Roberts and Tybout, 1997), being an exporter also provides a signal that the firm is sufficiently productive to generate enough profits in foreign markets to recover

[9] This argument relies on the assumption that business cycles are not perfectly coordinated across countries.

the sunk costs. This increases the likelihood that the firm will be able to service its external debt, and further relaxes the liquidity constraints that it faces.

To take firm heterogeneity into account, we estimate the following specification:

$$h(j,X) = 1 - exp[-exp(\beta_0 + \beta_1 IB*CONS*CRISIS + \beta_2 IB*CONS*(1-CRISIS) + \beta_3 IB*(1-CONS)*CRISIS + \beta_4 IB*(1-CONS)*(1-CRISIS) + \beta_5 CRISIS + \beta_6 LEVERAGE + \beta_7 SOLVENCY + \beta_8 PROFIT + \beta_9 SIZE + \beta_{10} AGE + \beta_{11} GROUP + \beta_{12} EXCHANGE + \gamma_j)] \quad (2)$$

where *CONS* is a dummy variable equal to 1 if the firm is (in turn) bank-dependent, young, or a non-exporter, and 0 otherwise. We expect the effect of a rise in the cost of finance on the survival of both constrained and unconstrained firms to be stronger during the financial crisis, as financial intermediaries became reluctant to lend money to these firms (Parker and Eaglesham, 2008; Bank of England, 2009; Fraser, 2009) and/or charged them higher interest rates (Bell and Young, 2010; Santos, 2013), further jeopardizing their survival chances (i.e. we expect to observe that $\beta_1 > \beta_2$ and that $\beta_3 > \beta_4$). Moreover, we expect an increase in *IB* to have a more severe impact on the survival of more bank-dependent firms compared to their less bank-dependent counterparts. The same is true for young versus old firms, as well as non-exporters versus exporters (i.e. we expect to observe that $\beta_1 > \beta_3$ and that $\beta_2 > \beta_4$).

IV. Data and summary statistics

Data

Our data set is drawn from the annual accounting reports taken from the *Financial Analysis Made Easy* (FAME) database, published by Bureau Van Dijk Electronic Publishing

(*BvDEP*). The full version of the FAME database provides information on 2.8 million companies (1.9 million of which are in a detailed format) over the period 2000–2009[10].

To construct our data set, we use three different versions of FAME. In particular, we employ FAME October 2010, FAME October 2008, and FAME February 2005. In line with Helmers et al. (2011) and Javorcik and Li (2013), we take this approach to address potential attrition bias since FAME keeps only firms that have not been inactive for more than four years. Therefore, if only the 2010 version of FAME were used, we would miss firms that exited by 2006 or possibly 2005. Thus, our dataset is able to track firm exits up to the earlier part of the sample period.

To accurately construct our dependent variable we also take into account that some firms may exit due to mergers and acquisitions. Following Helmers and Rogers (2010) and Görg and Spaliara (2014), we use Bureau Van Dijk's ZEPHYR database, which contains information on mergers and acquisitions, to identify and drop those firms that are mistakenly coded as "failed" in our data. This ensures that our indicator variable has been accurately constructed to capture firms that failed and did not exit due to mergers and acquisitions.

Following normal selection criteria used in the literature, we drop observations with negative sales, as well as observations with negative total assets. Firms that do not have complete records on our main regression variables are also dropped. To control for the potential influence of outliers, we exclude observations in the 1% tails for each of our regression variables. Our final panel, which is unbalanced, includes 20,238 firms and

[10] It is noteworthy that three types of access to the FAME database are available. Type C gives access to all firms in the database, while types B and A exclude in turn subsets of the smallest companies. Our dataset is based on type A access. In addition, a maximum of ten years of complete data history can be downloaded at once. We have only selected firms that have unconsolidated accounts: this ensures that the majority of the firms in our dataset are relatively small. Moreover, it avoids the double counting of firms belonging to groups, which would be included in the dataset if firms with consolidated accounts were also part of it.

136,982 observations[11]. This represents approximately 20% of the UK manufacturing sector excluding sole proprietorships and partnerships with self-employed owner-manager(s)[12]. The vast majority of firms included in this dataset are not traded on the stock market. This is an appealing characteristic since unquoted firms are more likely to be associated with a higher degree of information asymmetry and therefore more likely to face an increased probability of failure, especially during extreme economic conditions (Hughes, 1994)[13].

Summary statistics

Tables 1 presents descriptive statistics of all variables used in our empirical models for the entire sample. We distinguish between failed and surviving firms (columns 2 and 3); and crisis and tranquil periods (columns 5 and 6). In columns 4 and 7 we report *p*-values of a test for the equality of means. We can see that the average failure rate in our sample is 14.3%, which is much higher compared with previous UK studies (Bunn and Redwood, 2003 and Bridges and Guariglia, 2008). The difference between our figures and theirs is probably due to the fact that their sample covers a much earlier time period (up to 2003). It is therefore possible that failure rates have increased over the most recent years. Our figures are consistent with the *Structural Business Statistics* reported by Eurostat, according to which the average failure rate between 2000 and 2009 in the manufacturing sector is approximately 10%. When comparing failing and surviving firms (columns 2 and 3), we note that the former are charged a significantly higher interest for servicing short-term debt. Moreover, surviving firms are less indebted, more profitable, and less solvent

[11] See Section 2 of the online Appendix for information about the structure of our panel (Table A1) and for precise definitions of all the variables used. Also see Sections 3 and 4 of the online Appendix for a discussion on the representativeness of our sample and on whether our sample selection criteria generate bias.
[12] The data are taken from the Department of Business and Innovations Skills, Small and Medium-sized Enterprise Statistics for the UK and Regions (http://stats.bis.gov.uk/ed/sme).
[13] Also see Bunn and Redwood (2003), Bridges and Guariglia (2008), Helmers and Rogers (2010, 2011), and Görg and Spaliara (2014), who used the FAME dataset to study business failures in the UK.

than their failed counterparts. These findings are in line with Bunn and Redwood (2003), Bridges and Guariglia, (2008), and Görg and Spaliara (2014). Furthermore, survivors are larger, older, and more likely to be part of a group. These differences between sub-samples are statistically significant in all cases (column 4).

When comparing the 2007-09 financial crisis period with the earlier years of our sample (columns 5 and 6), we observe that the average failure rate is higher during the crisis. Yet, although the difference in failure rates during and outside the crisis is statistically significant at the 1% level (column 7), it is actually not very large. Three factors can explain the relatively low number of insolvencies over the crisis period. First, the relatively healthy position of the corporate sector prior to the crisis may have played a role. Second, the forbearance by banks on existing loans, together with the low level of the Bank Rate may have enabled businesses to continue trading despite the lower demand and related losses. Third, the relatively few company liquidations may be explained by effects of monetary and fiscal policies implemented during the financial crisis period (see Benito el al., 2010, and Bank of England, 2012). It should be noted, however, that the overall low number of UK insolvencies during the 2007-2009 period hides the fact that survival was a major problem for UK SMEs.

Moving to the interest burden, we note that this variable takes the value of 37.5% during the crisis, while it equals 35.8% during tranquil periods. Once again, this difference is statistically significant. It is also noteworthy that the average interest burden in our sample is higher than that reported by Benito (2005) and Benito and Young (2007). This can be explained considering that, contrary to ours, their study focuses on UK listed companies, which are likely to be less indebted than their unlisted counterparts. This higher interest burden during the crisis is driven by an increase in interest payments, rather than by a decline in cash flow. Specifically, according to our data, average interest

payments increased by 72% during the crisis period. The difference in the mean interest payment figures across the crisis and preceding periods is statistically significant at the 1% level. On the other hand, average cash flow actually increased by 5% in the crisis period, and the difference in mean cash flow during and before the crisis is only marginally significant[14]. This confirms that during the financial crisis, firms faced an increase in the debt-servicing cost. Specifically, the higher interest burden observed in the period 2007-2009 is mainly due to the increase in the spread over the reference rate at which loans were offered. As explained in Bank of England (2009), "increases in spreads are likely to reflect in part a re-pricing due to increased perceptions of credit risk, following a prolonged period earlier in the decade where corporate credit risks were underpriced" (pp. 6-7).[15]

In summary, these preliminary statistics suggest that firms' failure rates may be related to the interest burden, financial health, and the recent financial crisis. In the sections that follow, we provide a formal econometric analysis on the links between these variables[16].

V. Empirical results

Firm survival, financial crisis, and the role of interest burden

In this section we shed light on the role played by changes in the interest burden on firms' survival before and during the recent financial crisis. A few papers have considered the impact of financial pressure on firms' real decisions (Nickell and Nicolitsas, 1999; Benito, 2005; and Benito and Young, 2007). In particular, they have documented significant effects of debt-servicing costs on investment expenditures, dividend payments, inventory investment, and employment. Given that debt-servicing costs increased during the recent

[14] These numbers are not reported in the Table for brevity.
[15] A similar point with reference to UK loan spreads is also made by Bell and Young (2010). Also see Fraser (2009) for an illustration of the extent to which the cost of loans to SMEs increased during the recent financial crisis.
[16] Additional summary statistics are reported in Section 5 of the online Appendix.

crisis as evidenced by Bell and Young (2010), we take one step further and evaluate the effects of changes in the interest burden on firm survival, and assess whether these effects were magnified during the financial crisis. Table 2 presents the estimates of our survival equations. In column 1, the interest burden is included in the estimating equation along with a number of firm-specific and other control variables. The coefficient associated with the interest burden enables us to assess the consequences of a *ceteris paribus* increase in interest burden on the probability of firm exit. Column 2 includes both the interest burden and the crisis dummy, and column 3 includes the crisis dummy, as well as the indirect effect of the crisis through interactions with the interest burden.

Starting with column 1, we observe that the firm-specific interest burden exerts a positive and highly significant effect on firm failure. Considering that the predicted exit probability evaluated at the mean of the independent variables is 3.5 %, the coefficient on *IB* suggests that a one percent increase in the interest burden is associated with a rise in the predicted exit probability of around [exp(0.614)-1]*3.5= 2.96 percentage points. Consistent with our expectations, increases in the debt-servicing costs affect firms' survival prospects negatively. This is in line with other studies which find a negative effect of debt-servicing costs on investment expenditures, dividend payments, inventory investment, and employment (Nickell and Nicolitsas, 1999; Benito, 2005, and Benito and Young, 2007)[17,18].

Column 2 includes the crisis dummy and is aimed at evaluating the marginal effect of the crisis on firm survival, holding everything else equal. The crisis dummy attracts a

[17] Even though our equation controls for a range of variables that typically affect corporate death rates, one could argue that a higher interest burden and firm exit may be driven by the same unobservable variables and therefore may seem to occur at the same time, without a causal link running from the former to the latter. In order to convince readers that this is not the case, we show that our results are robust to lagging the interest burden, using Instrumental Variable (IV) pooled linear and probit models, a simple fixed-effects model, a conditional Logit fixed-effects model, an IV fixed-effects model, and a two stage least squares model estimated in first-differences. The results of these approaches are reported and discussed in Section 7 of the online Appendix.

[18] Other coefficients in the Table are discussed in Section 6 of the online Appendix.

positive coefficient, which can be explained considering that during downturns, economic activity faces a general slowdown which is likely to affect firm survival. The coefficients on the interest burden, control, and financial variables are similar to those reported in column 1.

When we include the interactions between the interest burden and the crisis/non-crisis dummies in column 3, we find a positive and highly significant effect of the firm-specific interest rate on the likelihood of exit both in and out of the crisis. However, the results suggest that firms respond differently to the financial pressure of servicing debt throughout the cycle: increases in interest payments have a greater impact on the hazard of failure during the crisis than outside. The difference in this effect across the two time periods is economically important: a one percent increase in the interest burden raises in fact the predicted exit probability by 9.68% over the period 2007-2009, but only by 2.18% during tranquil periods. The *p*-value for the equality of the coefficients indicates a statistically significant difference between the two coefficients. It is also interesting to notice that once the interaction terms are added to the equation, the *CRISIS* dummy loses its significance. This suggests that the crisis affected firm survival mainly indirectly, by magnifying the effect of changes in the interest burden. This can be explained in the light of the financial accelerator hypothesis, according to which the effects of changes in firms' balance sheet positions on their activities, and hence their survival, are magnified during recessionary periods (Bernanke et al., 1996; Perez-Quiros and Timmermann, 2000). Another explanation for our findings could be that, during the crisis, banks became less tolerant of companies facing a high interest burden, which may reflect a change in their risk appetite. In other words, because they were concerned about their own balance sheets due to the increased risk of non-performing loans and write-offs, banks monitored their borrowers more closely and became generally more cautious in their lending practices

(Kara et al., 2011). In line with this argument, Ivashina and Scharfstein (2010), Bell and Young (2010), and Almeida et al. (2013) note a significant reduction in the supply of bank credit in both the US and the UK during the crisis.

In a nutshell, our results so far suggest that higher levels of the interest burden are likely to have increased firms' chances of failure during the recent financial crisis. To provide further support to this conclusion, we have partitioned our sample into firm-years that experienced a rise in their interest burden, and firm-years whose interest burden either stayed constant or declined. Focusing on the entire sample, the former experienced an average failure rate of 16.11%, while the average failure rate of the latter was only 5.27%. The difference between the two rates is statistically significant at the 1% level. This confirms that an increasing interest burden is generally associated with a higher failure rate. In addition, as shown in Figure A12 in Section 8 of the online Appendix, only those firm-years that experienced a rise in the interest burden show a significant rise in their failure rates over the crisis period. Other observations actually show a declining failure rate[19]. This confirms that rising interest payments are likely to have been one of the driving factors explaining the high exit of firms during the recent financial crisis.

Differentiating firms according to their degree of bank dependency, age, and exporting activity

In Table 3, we investigate whether changes in interest payment obligations have a differential impact on the hazard of failure of firms more and less likely to face financing constraints, in and out of the crisis. We expect more bank-dependent firms to face a higher sensitivity of failure to changes in the interest burden. The same argument holds for young

[19] In unreported statistics, we show that it is mainly bank-dependent firms and non-exporters who suffered a significant increase in the interest burden over the crisis period.

and non-exporting firms, which are typically more financially constrained than their older and exporting counterparts.

We label bank-dependent (columns 1 and 2), young (column 3), and non-exporting firms (column 4) as "constrained". The interest burden is interacted with both the constrained/unconstrained dummies and the crisis/non-crisis dummies to gauge the extent to which the effects of debt-servicing cost on the likelihood of failure differ for more and less-financially constrained firms throughout the business cycle. The emphasis is put on the differential behavior of firms more likely to face financial constraints during and outside the crisis, but we also check for differences in the behavior of unconstrained firms over the two periods. To ensure that our results are robust, we carry out our estimations using two different classification criteria for bank dependency, based on firms' short-term debt to the sum of short-term debt and trade credit (*BankDep1*, column 1) and short-term debt to total current liabilities (*BankDep2*, column 2).

Focusing on rows 1 and 2 of Table 3, we observe that for bank-dependent, young, and non-exporting firms, the interest burden exhibits a much larger coefficient during the crisis than outside. A test for the equality of the coefficients is reported at the foot of the Table. It shows that the differences in the coefficients on the interest burden for constrained firms during and outside the crisis are statistically significant.

We next compare rows 3 and 4 and observe that the estimated coefficients on the interest burden are positive and significant for unconstrained firms both in and out of the crisis, and, once again, generally higher in the crisis. The *p*-values for the test of the differences in these coefficients show that they are once again statistically significant.

Next, we compare the coefficients on the interest burden at constrained and unconstrained firms during the crisis (rows 1 and 3). We observe that the sensitivity of the firms' chances of survival to changes in the interest burden is always higher for the former.

The *p*-values reported at the foot of the Table reveal that in two out of four cases, during the crisis, the coefficients on the interest burden for constrained firms are significantly different from those of unconstrained firms[20].

Access to capital markets is likely to be prohibitively expensive for financially constrained firms, which are more likely to depend on banks for external finance. During the financial crisis, the strong reliance of these firms on bank debt had disastrous effects on their viability given the shortage of bank credit available in the market. It is in fact documented that during the crisis, most banks tightened lending standards. As a consequence of this, those bank-dependent financially constrained firms had to scale back their investment projects and restrain their activities. Consequently, it is not surprising that following a rise in their debt obligations, more-bank-dependent, young and non-exporting firms were more likely to fail during the crisis.

The last pair of interactions to be compared are those in rows 2 and 4. Results for both constrained and unconstrained firms during tranquil periods are mixed. When bank dependency is used as a measure of constraints, the effect of changes in the interest burden on firm chances of survival is higher for more bank-dependent firms. Yet, when age and exporting are employed as sorting devices, the effect is higher for older and equal for exporting firms. In these cases, however, the differences in the relevant coefficients are not statistically significant at conventional levels.

In summary, the greater sensitivities of firm survival to changes in the interest burden documented for more-bank-dependent, young, and non-exporting firms during the

[20] This happens when we use the bank dependency criteria to differentiate firms into more and less likely to face financing constraints, and may be indicative of the importance of being bank-dependent during the crisis.

crisis than outside confirms that rising interest payments are likely to have been one of the driving factors explaining the high exit of financially constrained firms during the crisis[21].

VI. Conclusions

The literature on business failures has mainly considered the effects of direct measures of firms' balance sheet health on firms' survival chances. In this paper we take a different angle by examining, for the first time, the role of firm-specific interest payments, measured by the interest burden, in determining firm survival. Our results, based on firm-level data for the UK over the period 2000 to 2009, suggest that there is a strong link between debt-servicing costs and firm survival. This link is particularly strong during the 2007-09 financial crisis, during which firms became more likely to fail as a consequence of an increase in their interest burden. When we differentiate firms into more and less likely to face financing constraints, we find that survival chances at bank-dependent, younger, and non-exporting firms are the most severely affected by changes in interest payments, especially during the crisis. Our results are robust to using different estimation methods and different interest burden measures.

The increased cost of servicing debt which triggered the rise in the interest burden over the period 2007 to 2009 may have been a driving factor for many of the corporate failures which accompanied the crisis. This can be explained considering that banks became less tolerant of companies facing a high interest burden during the crisis, which may reflect a change in their risk appetite. In other words, because during economic slowdowns, banks face a higher risk of non-performing loans and write-offs, they tend to

[21] As our sample separation criteria (with the exception of age) may be endogenous, we tested whether our results were robust to using pre-sample bank dependency and export status to partition our sample. These results, which are not reported for brevity but available upon request, were very similar to those reported in Table 3. Our results were also robust to controlling for the possible endogeneity of our financial variables by using instrumental variables (IV) probit models, and to using an alternative measure of the interest burden, namely the ratio of interest payments to total debt. These robustness tests are discussed respectively in Sections 9 and 10 of the online Appendix.

monitor their borrowers more closely and are generally more cautious in their lending practices (Kara et al., 2011). The reduction in the supply of bank loans directed towards firms with a high interest burden is likely to have prevented these firms from investing, and ultimately to have hastened their exit from the market.

The resulting policy implications are important, in particular, but not only, in the current economic climate. We suggest that policymakers should prevent financing costs from rising during economic downturns. This implication is reflected in the extraordinary measures the Bank of England has taken during the financial crisis period. Specifically, the fact that the Bank of England's own policy rate was reduced to a historic low of 0.5% is likely to have significantly contributed to the lower corporate failure rates. In addition, several other policies aimed at making low cost credit readily available to financially constrained firms, such as the £190 billion Project Merlin, the National Loan Guarantee Scheme, the Funding for Lending Scheme (FLS), and the Discount Window Facility (DWF) are also likely to have helped stabilise the UK market and improve firms' performance and survival prospects[22].

References

Almeida, H., Campello, M., Cunha, I., and Weisbach, M. (2013). 'Corporate liquidity management: A conceptual framework and survey', National Bureau of Economic Research Working Paper No. 19502.

Bandick, R. and H. Görg (2010). 'Foreign acquisition, plant survival, and employment growth', *Canadian Journal of Economics,* Vol. 43, pp. 547-573.

Bank of England (2009). *Trends in Lending*, May 2009.

Bank of England (2012). *Inflation Report*, November 2012.

[22] These policies are described in Section 11 of the online Appendix.

Bell, V. and G. Young (2010). 'Understanding the weakness of bank lending', *Quarterly Bulletin,* Q4, Bank of England.

Benito, A. (2005). 'Financial pressure, monetary policy effects and inventories: firm-level evidence from a market-based and a bank-based financial system', *Economica,* Vol. 72, pp. 201–224.

Benito, A. Nelss, K., Price, S. and K. Rachel (2010). 'The impact of the financial crisis on supply', *Quarterly Bulletin,* Q2, Bank of England.

Benito, A. and J. Whitley (2003). 'Implicit interest rates and corporate balance sheets: An analysis using aggregate and disaggregated UK data', Working Paper No. 193, Bank of England.

Benito, A. and G. Young (2007). 'Financial pressure and balance sheet adjustment by firms', *Oxford Bulletin of Economics and Statistics,* Vol. 69, pp. 581-602.

Bernanke, B. and M. Gertler. (1995). 'Inside the black box: The credit channel of monetary policy transmission', *Journal of Economic Perspectives,* Vol. 9, pp. 27-48.

Bernanke, B., Gertler, M., and Gilchrist, S. (1996). 'The financial accelerator and the flight to quality', *Review of Economics and Statistics,* Vol. 78, pp. 1-15.

Bridges, S. and A. Guariglia (2008). 'Financial constraints, global engagement, and firm survival in the U.K.: Evidence from micro data', *Scottish Journal of Political Economy,* Vol. 55, pp. 444-464.

Bunn, P. and V. Redwood (2003). 'Company accounts based modelling of business failures and the implications for financial stability', Working Paper No. 210, Bank of England.

Fraser, S. (2009). 'Small firms in the credit crisis: evidence from the UK survey of SME finances.' Warwick Business School (ESRC grant no. RES-177-25-0007).

Goodhart, C. (2008). 'The background to the 2007 financial crisis', *International Economics and Economic Policy,* Vol. 4, pp. 331–346.

Görg, H. and M.E. Spaliara (2014). 'Financial health, exports, and firm survival: Evidence from UK and French firms', *Economica*, Vol. 81, pp. 419-444.

Greenaway, D., Guariglia, A., and Kneller, R. (2007). 'Financial factors and exporting decisions', *Journal of International Economics,* Vol. 73, pp. 377-95.

Guariglia, A. and Mateut, S. (2006). 'Credit channel, trade credit channel, and inventory investment: Evidence from a panel of UK firms', *Journal of Banking and Finance,* Vol. 30, pp. 2835-56.

Guariglia, A. and Mateut, S. (2010). 'Inventory investment, global engagement, and financial constraints in the UK: evidence from micro data', *Journal of Macroeconomics,* Vol. 32, pp. 239-50.

Hadlock, C. and Pierce, J. (2010). 'New evidence on measuring financial constraints; Moving beyond the KZ index', *Review of Financial Studies,* Vol. 23, pp. 1909-1940.

Helmers, C. and M. Rogers (2010). 'Innovation and the survival of new firms in the UK', *Review of Industrial Organization,* Vol. 36, pp. 227-248.

Helmers, C. and M. Rogers (2011). 'Does patenting help high-tech start-ups?' *Research Policy,* Vol. 40, pp. 1016-1027.

Helmers, C., Rogers, M., and P. Schautschick (2011). 'Intellectual property at the firm-level in the UK: The Oxford firm-level intellectual property database', Working Paper No. 546, University of Oxford

Huang, Z. (2003). 'Evidence of a bank lending channel in the UK', *Journal of Banking and Finance,* Vol. 27, pp. 491-510.

Hughes, A. (1994). 'Finance for SMEs: a UK perspective', *Small Business Economics,* Vol. 9, pp. 151-168.

Ivashina, V. and D. Scharfstein (2010). 'Bank lending during the financial crisis of 2008', *Journal of Financial Economics,* Vol. 97, pp. 319–338.

Javorcik, B. and Y. Li (2013). 'Do the biggest aisles serve a bright future? Global retail chains and their implications for Romania', *Journal of International Economics,* Vol. 90, pp. 348-63.

Kahle, K. and R. Stulz (2013). 'Access to capital, investment, and the financial crisis', *Journal of Financial Economics,* Vol. 110, pp. 280-299.

Kara, A., Marques, D., and S. Ongena. (2011). 'Securitization and lending standards: Evidence from the wholesale market', European Central Bank, Working Paper No. 1362.

Kashyap, A., Stein, J., and W. Wilcox. (1993). 'Monetary policy and credit conditions: evidence from the composition of external finance', *American Economic Review,* Vol. 83, pp. 78-98.

Kirkup, J. and R. Tyler (2008). 'Interest rate cut: Small businesses could save £750 million on loans', *The Telegraph*, 06 November 2008.

Kuchler, H. (2012). 'Poor access to cash limits SME growth', *Financial Times*, March 11.

Mojon, B. Smets, F. and P. Vermeulen (2002). 'Investment and monetary policy in the Euro area', *Journal of Banking and Finance,* Vol. 26, pp. 2111–2129.

Nickell, S. and D. Nicolitsas (1999). 'How does financial pressure affect firms?' *European Economic Review,* Vol. 43, pp. 1435–1456.

Parker, G. and J. Eaglesham (2008). 'Darling lifeline for small companies', *Financial Times* (19 November).

Perez-Quiros, G and Timmermann, A. (2000). 'Firm size and cyclical variations in stock return', *Journal of Finance,* Vol. LV, pp. 1229-1262.

Roberts, M. and Tybout, J. (1997). 'The decision to export in Colombia: an empirical model of entry with sunk costs', *American Economic Review,* Vol. 87, pp. 545–64.

Rose, A. and M. Spiegel (2011). 'Cross-country causes and consequences of the crisis: An update', *European Economic Review*, Vol. 55, pp. 309-24.

Santos, J. (2011). 'Bank corporate loan pricing following the subprime crisis', *Review of Financial Studies,* Vol. 24, pp. 1916-43.

Santos, J. and A. Winton (2008). 'Bank loans, bonds, and informational monopolies across the business cycle', *Journal of Finance,* Vol. 63, pp. 1315-1359.

Spaliara, M. (2009). 'Do financial factors affect the capital-labour ratio? Evidence from UK firm-level data', *Journal of Banking and Finance,* Vol. 33, pp. 1932-1947.

Tsoukas, S. (2011). 'Firm survival and financial development: Evidence from emerging Asian economies', *Journal of Banking and Finance,* Vol. 35, pp. 1736-1752.

Vermeulen, P. (2002). 'Business fixed investment: Evidence of a financial accelerator in Europe', *Oxford Bulletin of Economics and Statistics,* Vol. 64, pp. 217- 235.

TABLE 1: *Summary statistics*

	Total Sample (1)	*Fail=1* (2)	*Fail=0* (3)	*Diff.* (4)	*Crisis=1* (5)	*Crisis=0* (6)	*Diff.* (7)
Fail	0.143	1.00	0.000	-	0.148	0.141	0.002
	(0.35)	(0.00)	(0.00)		(0.35)	(0.34)	
IB	0.362	0.496	0.351	0.000	0.375	0.358	0.000
	(0.38)	(0.41)	(0.38)		(0.39)	(0.38)	
Leverage	0.475	0.577	0.471	0.000	0.440	0.489	0.000
	(0.35)	(0.58)	(0.33)		(0.29)	(0.37)	
Solvency	0.423	0.448	0.421	0.002	0.472	0.404	0.000
	(0.53)	(0.64)	(0.53)		(0.35)	(0.59)	
Profit	0.085	0.063	0.086	0.000	0.088	0.084	0.001
	(0.19)	(0.31)	(0.18)		(0.17)	(0.19)	
Size	3.917	3.531	3.939	0.000	4.026	3.875	0.000
	(1.31)	(1.21)	(1.32)		(1.34)	(1.30)	
Age	26.312	25.012	26.529	0.000	28.357	25.479	0.000
	(22.39)	(22.00)	(22.44)		(22.65)	(22.22)	
Group	0.192	0.069	0.212	0.000	0.213	0.183	0.000
	(0.39)	(0.25)	(0.41)		(0.41)	(0.38)	
Exchange	96.948	96.791	96.974	0.004	84.213	102.137	0.000
	(15.51)	(11.63)	(11.49)		(9.20)	(7.69)	
Observations	136,982	19,634	117,348		39,661	97,321	

Notes: The table presents sample means. Standard deviations are reported in parentheses. *Fail* is a dummy that equals 1 in a given year if the firm is recorded as failed in that year, and 0 otherwise. *Crisis* is a dummy representing the recent financial crisis. It takes value 1 in the years 2007-2009, and 0 otherwise. *IB* is defined as the ratio of interest payments to cash flow. *Leverage* is measured as the firm's total current liabilities to assets ratio. *Solvency* is defined as the ratio of the firm's shareholders' funds over its total assets. *Profit* is the ratio of the firm's profits before interest and tax to its total assets. *Size* is given by the log of the firm's real assets measured in thousands of UK sterling. *Age* is defined as the difference between the present year and the firm's date of incorporation. *Group* is a dummy variable equal to 1 if the firm is part of a group (UK or foreign), and 0 otherwise. *Exchange* is the real effective exchange rate. *Diff.* is the *p*-value of the test statistic for the equality of means.

Table 2: *Firm survival and the financial crisis*

Fail	***Baseline*** (1)	***IB and Crisis*** (2)	***IB*Crisis*** (3)
IB	0.614***	0.614***	
	(8.77)	(8.77)	
Crisis		0.910**	0.383
		(2.15)	(0.89)
IB*Crisis			1.326***
			(8.10)
IB*(1-Crisis)			0.484***
			(6.91)
Solvency	-0.420***	-0.420***	-0.378**
	(-2.80)	(-2.80)	(-2.51)
Leverage	0.496***	0.496***	0.517***
	(3.39)	(3.39)	(3.55)
Profit	0.054	0.054	0.063
	(0.48)	(0.48)	(0.59)
Size	-0.341***	-0.341***	-0.342***
	(-12.00)	(-12.00)	(-12.10)
Age	-0.000	-0.000	-0.001
	(-0.27)	(-0.27)	(-0.31)
Group	-0.583***	-0.583***	-0.581***
	(-5.22)	(-5.22)	(-5.20)
Exchange	0.157***	0.157***	0.154***
	(5.59)	(5.59)	(5.46)
Constant	-16.012***	-16.922***	-16.539***
	(-6.94)	(-6.23)	(-6.09)
F-test of equality (p-value)for IB			0.000
Observations	58,955	58,955	58,955
Log-Likelihood	-8,403	-8,403	-8,384

Notes: All estimates were obtained using a proportional hazard model. The dependent variable is a dummy equal to 1 if the firm fails, and 0 otherwise. Time and industry dummies were included in all models. Robust z-statistics are presented in parentheses. Standard errors are clustered at the firm level. The *F*-test of equality for *IB* refers to the test of equality between *IB*Crisis and IB*(1-Crisis).* Also see notes to Table 1. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

TABLE 3: *Firm survival, financing constraints, and the crisis*

Fail	***Cons= f(BankDep1)***	***Cons= f(BankDep2)***	***Cons= f(Young)***	***Cons= f (Non-Exporter)***
	(1)	(2)	(3)	(4)
IB*Cons* Crisis	1.667***	1.583***	1.325***	1.349***
	(8.38)	(7.93)	(7.17)	(7.48)
IB*Cons*(1-Crisis)	0.702***	0.676***	0.458***	0.484***
	(8.10)	(7.87)	(5.09)	(6.23)
IB*(1-Cons)* Crisis	1.037***	1.145***	1.322***	1.298***
	(5.59)	(6.33)	(7.00)	(6.88)
IB*(1-Cons)*(1-Crisis)	0.238***	0.346***	0.509***	0.484***
	(2.60)	(3.97)	(5.77)	(5.22)
Crisis	0.148	0.135	0.384	0.382
	(0.34)	(0.31)	(0.89)	(0.88)
Solvency	-0.460***	-0.389**	-0.381**	-0.379**
	(-2.86)	(-2.44)	(-2.52)	(-2.51)
Leverage	0.688***	0.615***	0.517***	0.517***
	(4.26)	(3.86)	(3.54)	(3.54)
Profit	-0.027	-0.007	0.060	0.063
	(-0.19)	(-0.05)	(0.55)	(0.59)
Size	-0.323***	-0.324***	-0.342***	-0.341***
	(-10.98)	(-11.14)	(-12.07)	(-11.95)
Age	-0.000	-0.000	-0.001	-0.001
	(-0.06)	(-0.19)	(-0.43)	(-0.30)
Group	-0.569***	-0.584***	-0.581***	-0.581***
	(-4.88)	(-5.14)	(-5.19)	(-5.20)
Exchange	0.140***	0.141***	0.154***	0.154***
	(4.91)	(4.94)	(5.46)	(5.46)
Constant	-15.292***	-15.356***	-16.529***	-16.539***
	(-5.56)	(-5.59)	(-5.60)	(-5.60)
F-test of equality (p-value)				
IB*Cons	0.000	0.000	0.000	0.000
IB*(1-Cons)	0.002	0.000	0.000	0.001
IB*Crisis	0.000	0.011	0.986	0.762
IB*(1-Crisis)	0.000	0.000	0.648	0.997
Observations	53,292	54,989	58,955	58,955
Log-Likelihood	-7,554	-7,866	-8,383	-8,384

Notes: All estimates were obtained using a proportional hazard model. The dependent variable is a dummy equal to one if the firm fails, and zero otherwise. Time and industry dummies were included in all models. Robust z-statistics are presented in parentheses. Standard errors are clustered at the firm level. *Cons* is a dummy variable equal to 1 if the firm is financially constrained, and 0 otherwise. It is based, in turn, on *BankDep(1/2)*, *Young*, and *Non-exporter*. *BankDep1(2)* is equal to 1 in a given year for firm *i* if its *mix1(2)* is in the top 50% of the distribution of the *mix1(2)*s of all firms operating in the same industry as firm *i* in that year, and 0 otherwise. *Mix1* is the ratio of short-term debt to the sum of short-term debt and trade credit. *Mix2* is the ratio of short-term debt to total current liabilities. *Young* is equal to 1 for firm *i* in year *t* if this firm's age falls in the lower 50% of the age distribution of all firms operating in the same industry as firm *i* in that year, and 0 otherwise. *Non-exporter* is a dummy variable equal to 1 if the firm has never reported a positive amount of exports throughout the sample period, and 0 otherwise. With reference to the *F*-test of equality, *IB*Cons* refers to the test of equality between *IB*Cons*Crisis* and *IB*Cons*(1-Crisis)*. *IB*(1-Cons)* refers to the test of equality between *IB*(1-Cons)*Crisis* and *IB*(1-Cons)*(1-Crisis)*. *IB*Crisis* refers to the test of equality between *IB*Cons*Crisis* and *IB*(1-Cons)*Crisis*. Finally, *IB*(1-Crisis)* refers to the test of equality between *IB*Cons*(1-Crisis)* and *IB*(1-Cons)*(1-Crisis)*. Also see notes to Table 1.*: significant at 10%; **: significant at 5%; ***: significant at 1%.

To what Extent Does the Interest Burden Affect Firm Survival? Evidence from a Panel of UK Firms during the Recent Financial Crisis*

ALESSANDRA GUARIGLIA[+], MARINA-ELIZA SPALIARA[++], AND SERAFEIM TSOUKAS[++]

[+] *Department of Economics, University of Birmingham, Edgbaston,* Birmingham, B15 2TT, *UK. (e-mail: a.guariglia@bham.ac.uk)*

[++, +++] *Department of Economics, Adam Smith Business School, Gilbert Scott Building, University of Glasgow, Glasgow, G12 8QQ, UK. (e-mail: serafeim.tsoukas@glasgow.ac.uk, marina.spaliara@glasgow.ac.uk)*

Online Appendix

* JEL Classification numbers: D21; E22; E32; G31.

1. Description of the variables included in vector *X* in Equation (1)

In addition to the interest burden, *X* comprises a vector of financial variables aimed at capturing the effect of financial health on the likelihood of survival. Specifically, following Clementi and Hopenheyn's (2006) theoretical model, we control for three dimensions of the health of a firm's balance sheet, namely solvency, leverage and profitability. We define solvency (*SOLV*) as the ratio of shareholders' funds to total assets. This variable has been used in earlier studies as an indicator of firms' liquidity (Mateut et al., 2006). We expect less liquid firms to be more likely to fail, as they have less internal finance at hand.

As an additional balance sheet indicator, we consider the firm's leverage ratio (*LEV*), which is defined as the ratio of the firm's current liabilities to total assets, and measures the firm's overall indebtedness. Higher levels of existing debt are often associated with a poorer balance sheet, and thus firms with higher levels of debt face greater difficulties obtaining external finance, and are hence constrained in their investment and growth (Zingales, 1998; Görg and Spaliara, 2014). We therefore expect to observe a positive relationship between leverage and the probability of failure.

The profitability ratio (*PROF*) is defined as the ratio of earnings before interest and taxes to total assets. Following Bunn and Redwood (2003), and Bridges and Guariglia (2008), we use this variable as a proxy for firm efficiency. We expect to observe a negative relationship between firms' profitability and their probability of failure.

The vector *X* also includes additional firm-specific characteristics. These control variables are chosen following previous work on firm survival. Firm size (*SIZE*) is measured as the logarithm of total real assets. According to Geroski (1995) and Clementi and Hopenhayn (2006), large firms are less at risk of failure than small firms. Large firms are in fact likely to have access to more sources of external finance than small firms, which are predominantly bank-dependent. Hence, when banks interrupt their lines of credit, which is likely to happen during extreme economic conditions, large firms experience higher survival probabilities than their smaller counterparts. We therefore expect to find a positive relationship between firm size and the probability of survival. We also include the firm's age (*AGE*), defined as the difference between the present year and the firm's date of incorporation. Firms with an established track record are less likely to fail than younger firms because they have acquired reputation in the market and therefore face a smaller

liquidation risk (Hadlock and Pierce, 2010). Consequently, we expect to observe a negative association between age and the incidence of failure.

Furthermore, we account for whether a firm is part of a group (UK or foreign). Specifically, we construct the dummy variable *GROUP*, which takes the value one if a firm is part of a group, and zero otherwise. We expect to observe a negative relationship between this variable and the hazard of failure since group firms are likely to have better access to capital markets and to respond more quickly to shocks than single firms, due to better information processing (Disney et al., 2003; and Bridges and Guariglia, 2008).

We also control for macroeconomic conditions by including the real effective exchange rate in our model[1]. In line with Baggs et al. (2009), who document a negative association between survival and appreciation of the Canadian dollar, we expect the exchange rate (*EXCHANGE*) to decrease the survival prospects of firms[2]. Lastly, the vector *X* contains a set of industry and time dummies that control respectively for industry and business cycle effects.

2. More details about the dataset and the variables used

Structure of the panel

Table A1 shows the structure of our panel.

Definitions of the variables used

FAIL: dummy variable (DV) equal to 1 if the firm is recorded as failed in a given year, and 0 otherwise. We define a firm as failed when its status is that of receivership, liquidation, or dissolved.

IB: ratio of interest payments to cash flow (which is defined as profit and loss after taxes plus depreciation).

IB2: ratio of interest payments to total debt.

LEV: ratio of current liabilities to total assets.

SOLV: ratio of shareholders' funds to total assets.

PROF: ratio of profits before interest and tax to total assets.

[1] Following the Bank for International Settlements' methodology, we calculate the effective exchange rate as the geometric weighted average of bilateral exchange rates adjusted by relative consumer prices.

[2] The intuition behind this prediction is the following: an appreciation of the domestic currency gives foreign firms a cost advantage, which intensifies the competition faced by domestic firms, forcing them to reduce the prices they charge up to a point at which they might be forced to exit the market (Baggs et al., 2009).

SIZE: logarithm of real total assets.

AGE: difference between the present year and the firm's date of incorporation.

GROUP: DV equal to 1 if the firm is part of a group (UK or foreign), and 0 otherwise.

MIX1: ratio of short-term debt to the sum of short-term debt and trade credit.

MIX2: ratio of short-term debt to total current liabilities.

BANKDEP1(2): DV equal to 1 in a given year for a given firm *i* if its *MIX1(2)* is in the top 50% of the distribution of the *MIX1(2)* of all firms operating in the same industry as firm *i* in that year, and 0 otherwise.

YOUNG: DV equal to 1 for firm *i* in year *t* if this firm's age falls in the lower 50% of the age distribution of all firms operating in the same industry as firm *i* in that year, and 0 otherwise.

NON-EXPORTER: DV equal to 1 if the firm has never reported a positive amount of exports (which are measured as overseas turnover) throughout the sample period, and 0 otherwise.

EXCHANGE: effective exchange rate calculated as the geometric weighted average of bilateral exchange rates adjusted by relative consumer prices.

DEFLATORS: all variables are deflated using the industry-specific price of output

Correlation matrix

Table A2 shows the correlation matrix among all variables used in the paper. As can be observed, the correlation coefficients between regressors are not large enough to indicate any collinearity problem.

3. Is our data sample representative? Comparing the average failure rate and the average growth of profitability in our sample with those of the UK manufacturing sector, as reported in the ONS database

It is noteworthy that the availability of financial information in FAME varies considerably across firms. As Eberhardt and Helmers (2010) and Helmers et al. (2011) point out, larger firms provide a much broader range of financial information compared to smaller companies for which only an abridged balance sheet is required. On the other hand, Faggio et al. (2007) and Draca et al. (2011) argue that unlisted firms in the UK are required to report significantly more accounting information compared to their US counterparts. In any event, to ensure that our sample is representative, we contrast it to aggregate data for the UK manufacturing sector. In Figures A1 and A2, we compare the average failure rate and the

average growth of profitability in our sample with those of the UK manufacturing sector, as reported in the ONS database. The series are highly correlated and exhibit similar business cycle dynamics, which suggests that our sample is reasonably representative of the broader aggregate.

4. Do our sample selection criteria generate a bias in our sample?

In order to answer this question, we provide two sets of comparisons. First, we compare the failure rate, debt ratio, and solvency ratio for our full sample and for those firms that were dropped in estimation. Second, we compare failure rates in the sample we used in estimation with those of the entire FAME dataset for various categories of firms.

Comparing the failure rate, debt ratio, and solvency ratio for our full sample and for those firms that were dropped in estimation.

Figures A3 to A5 compare the evolution over time of the failure rate (Figure A3), the debt ratio (Figure A4), and the solvency ratio (Figure A5) for our full sample and for those firms which were dropped in estimation. We do not observe significant differences between the two groups of firms.

Comparing failure rates in the sample we used in estimation with those of the entire FAME dataset for various categories of firms

Figures A6 to A11 compare the evolution over time of the failure rates in the sample we used in estimation with those in the entire FAME dataset for the full sample (Figure A6), young and old firms (Figure A7), small and large firms (Figure A8), firms belonging to industrial groups 1 to 3 (Figure A9), firms belonging to industrial groups 4 to 6 (Figure A10), and firms belonging to industrial groups 7 to 9 (Figure A11)[3]. We observe that for most of the groups of firms considered, the failure rates in the sample we used in estimation and the entire FAME database are similar.

Both sets of comparisons show that our sample selection criteria do not create bias in our sample.

[3] Industrial groups are defined using Blundell et al.'s (1992) classification, namely metals and metal goods (Group 1); other minerals, and mineral products (Group 2); chemicals and man-made fibres (Group 3); mechanical engineering (Group 4); electrical and instrument engineering (Group 5); motor vehicles and parts, other transport equipment (Group 6); food, drink, and tobacco (Group 7); textiles, clothing, leather, and footwear (Group 8); and others (Group 9).

5. Additional summary statistics

Summary statistics for firms in different industrial groups

Table A3 presents descriptive statistics for our main variables for firms belonging to the different industrial groups listed in footnote 3.

Summary statistics for different groups of firms based on the degree of asymmetric information that they face.

Table A4 presents summary statistics differentiating firms into bank-dependent and non bank-dependent; young and old; and exporters and non-exporters. These statistics suggest that more bank-dependent firms have a higher failure rate, as well as a significantly higher interest burden than their less bank-dependent counterparts. Young firms also display higher failure rates, as well as a higher interest burden than their older counterparts. Finally, although non-exporters display higher failure rates than exporters, surprisingly, they show a slightly lower interest burden.

6. Discussion of the coefficients of variables other than the interest burden in column 1 of Table 2 n the paper

Focusing on the estimates reported in column 1 of Table 2 in the paper, we observe that firms with high levels of leverage face higher probabilities of failure compared to their low leverage counterparts, confirming previously reported empirical evidence (Zingales, 1998; Görg and Spaliara, 2014). This can be explained considering that high levels of debt increase moral hazard and asymmetric information problems, which can in turn lead to a higher probability of failure. The coefficients on solvency show that liquidity affects the likelihood of failure negatively. This is in line with our expectations and with evidence presented by other studies (Mateut et al., 2006). Furthermore, the coefficient on profitability is insignificant. Focusing on the remaining control variables, size exerts a negative and significant effect on the probability of failure, whereas age has an insignificant impact. In accordance with Bridges and Guariglia (2008), being part of a group improves the survival prospects of firms. Lastly, as in Baggs et al. (2009), a stronger local currency raises the probability of firm failure.

7. Ensuring that a higher interest burden and firm exit are not driven by the same unobservable variables

It is possible that the Interest Burden (*IB*) is correlated with some omitted or unobserved variables that also affect the probability of firm exit. In this case, both the *IB* and the probability of exit may seem to occur at the same time, without a causal link running from the former to the latter. We have already controlled for a range of variables that typically affect corporate death rates (size, age, whether the firm is part of a group, the real effective exchange rate), as well as for a range of financial variables (solvency, leverage, and profitability). Nevertheless there may be other variables, such as for example, the education or experience of the CEO (which is time-invariant) or the firm's innovation activities (which is time-varying), which may affect both the company's survival chances and its *IB*.

We deal with this potential omitted variable bias (OVB) problem in four ways. The first is by lagging the interest burden in our model. This enables us to deal with the time-variant omitted variables bias. It is unlikely that, for example, innovation activities this year affect the firm's *IB* last year. The results for the baseline model, which are presented in Table A5, suggest that the lagged interest burden is still a significant determinant of firms' survival chances.

The second way we deal with the potential OVB problem is through our Instrumental Variable (IV) specifications. The IV technique allows us to estimate the coefficient associated with the interest burden consistently (free of bias caused by omitted variables) without having data on the omitted variables. Specifically, we instrument *IB* with the Bank of England base rate and the ten year government bond yield. These instruments are strongly correlated with *IB* (as shown by the tests for instrument validity discussed in point 9 below), but unlikely to be correlated with both the time-variant and the time-invariant omitted variables, as well as with the firm's survival chances. The results of the pooled linear IV and Probit IV estimations for the baseline model are reported respectively in column 1 of Table A8 and column 1 of Table A11[4]. The latter are discussed in detail in Section 9 below.

The third way we deal with the OVB problem is by using a fixed-effects model. By estimating the model in differences from the mean, this method controls for any time-invariant variable which may have been omitted from the model. In Table A6, we present estimates of our baseline Equation for two versions of this model: a fixed-effects linear

[4] In these specifications, leverage, solvency, and profit are also considered as endogenous and instrumented using their own lags.

model (column 1) and a conditional fixed-effects Logit model (Chamberlain, 1980, column 2). It should be noted that given the nature of our dependent variable, a fixed-effects linear probability model is problematic as it fails to properly capture the curvature of the regression function in the proximity of 0 and 1. The conditional fixed-effects Logit model (Chamberlain, 1980) does not suffer from this problem, and, like the fixed-effects model, it allows the regressors and the firm-specific component of the error term to be correlated. Yet, a contribution to the likelihood only arises from those groups of firms that exhibit a change in status (here, from alive to dead), and the group of firms that exhibit no change in status are discarded. In particular, all the firms for whom the dependent variable is either always 0 or always 1 are dropped from the sample used in estimation. This explains the very low sample size in column 2 of Table A6. The adverse effect of the interest burden on firm survival remains highly significant and unchanged.

It should be noted, however, that neither the fixed-effects linear model, nor the conditional fixed-effects Logit model control for time-varying omitted variables. For this reason, in Table A7, we report two sets of Instrumental Variable regressions which also control for fixed effects. Column 1 reports linear fixed effects estimates where all financial variables are treated as endogenous and instrumented. Column 2 reports a two stage least squares model estimated in first-differences where, as in column 1, all financial variables are treated as endogenous and instrumented. In both columns, the instrument set includes the base interest rate and the ten year government bond yield, as well as lags of solvency, profitability, and leverage. This approach allows us to take into account both time-invariant omitted variables (by first-differencing or by including fixed effects) and the time-varying omitted variables (by instrumenting *IB* and other financial variables). The results confirm once again that a higher Interest Burden still plays a positive and significant effect on firms' exit chances.

In summary, we can conclude that it is unlikely that both a higher interest burden and exit are driven by the same unobservable variables and therefore seem to occur at the same time, without a causal link running from the former to the latter.

8. Plotting Failure rates for firm-years that experienced a rise in the interest burden (H.IB) versus firm-years whose interest burden either stayed constant or declined (L.IB)

Figure A12 plots failure rates over time of those firm-years that experienced a rise in the interest burden and those that did not. The Figure is discussed in Section V of the paper.

9. Controlling for the possible endogeneity of IB and other financial variables

While the results presented in Section V of the paper are robust to using alternative definitions of financing constraints, they may be affected by endogeneity bias. To address this problem, we employ an instrumental variables (IV) probit model. We assume that both the interest burden and the financial variables are potentially endogenous and instrument the former using the Bank of England base interest rate and the ten year government bond yield[5], and the latter using their own lags. The results, which are reported in Tables A11 and A12, show that the effect of the interest burden on firm survival remains significant with a sizeable magnitude[6,7]. Moreover, changes in *IB* have a significant effect on firm survival chances only in the crisis period (Table A11). The results also suggest that the coefficients associated with the interest burden for both financially constrained and unconstrained firms are only statistically significant during the crisis (Table A12). Furthermore, during the crisis period, the sensitivity of firms' survival chances to changes in *IB* is higher for constrained than unconstrained firms, with a difference which is significant in two out of four comparisons. In sum, we conclude that our findings are robust to controlling for the possible endogeneity of our regressors.

*Tests for instrument validity***.** Tables A8 and A10, which report the main regression results using a pooled IV estimator, also present p-values for the following tests of instrument validity: Sargan test; Anderson test; Wald test; and Kleibergen-Paap rk LM test. IV methods rely on two assumptions. The first is that the excluded instruments are distributed

[5] The base rate is the level of interest set by the Central Bank and is a measure of monetary policy stance. This variable is comparable to the Federal Funds rate which is typically used to measure monetary conditions in the US. The interest rate that the Bank sets affects the lending costs to financial institutions, which then affect a whole range of interest rates set by commercial banks and other financial institutions. This has a direct effect on borrowers, hence the effect on the *IB*. Government bond yields can go up if the Central Bank increases its target for the interest rate (in other words, if it tightens monetary policy). Consequently higher government bond yields influence the interest rates individuals and businesses pay to borrow money.

[6] It should be noted that the number of observations reported in these Tables is lower than the corresponding number in Tables 2 and 3 in the paper due to the use of lagged variables as instruments.

[7] Our main regression results were robust to using a pooled IV estimator, the results of which are reported in Tables A8 and A10.

independently of the error process, and the second, that they are sufficiently correlated with the included endogenous regressors. The Sargan test is a test for overidentifying restrictions, which addresses the first assumption. More specifically, the joint null hypothesis which is tested is that the instruments are uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. Under the null hypothesis, the test has a large sample chi-squared distribution with degrees of freedom equal to the number of overidentifying restrictions. A p-value higher than 0.05 suggests that the null cannot be rejected at the 5% level, whilst a p-value lower than 0.05 indicates that at least one instrument is invalid. It should be noted that the Sargan test is only valid if the relevant equation is overidentified, with more excluded instruments than included endogenous variables.

To test the second assumption, we should consider the goodnesss-of-fit of the first stage regression relating each endogenous regressor to the entire set of instruments. A rule of thumb for instrument validity is that the F-statistic associated with the first stage regression be greater than 10. First stage regression results for the IV specifications reported in column 1 of Table A8 are presented in Table A9. The large F statistics suggest that our instruments have high explanatory power, and are therefore valid.

Additional tests of the second hypothesis are the Anderson test of the null hypothesis that the minimum canonical correlation is zero. Failure to reject the null suggests that the equation is unidentified. The Kleibergen-Paap test is an underidentification test, which tests whether or not the instruments are adequate to identify the equation. In both cases, a significant result (i.e. a p-value smaller than 0.05) suggests that the model is identified, meaning that the relationship between the included endogenous regressors and the instruments is sufficiently strong to justify inference from the results. An insignificant test statistic (i.e. a p-value larger than 0.05) indicates that the model is underidentified or too weakly identified (due to the weak relationship between the endogenous regressors and the instruments) to justify inference from the model. We can see from Tables A8 and A10 that both tests suggest that our model is identified.

A further condition for IV estimators to work is for the instrumented variables to be exogenous. In our Tables, we present a Wald test for exogeneity, whereby the null hypothesis is that all regressors are exogenous. Specifically, the Wald test for exogeneity tests whether the residuals from the first stage regression are correlated with those from the final model. The correlation of an exogenous model is zero. The test statistic has a $\chi 2$ distribution. A p-value lower than 0.05 suggests that the null hypothesis needs to be

rejected, and that it therefore appropriate to use an IV estimator. The test statistics reported in Tables A8 and A10 suggest that the null that all regressors are exogenous can be rejected[8].

10. Regression results using an alternative measure of the Interest Burden

Tables A13 and A14 report our main regression results based on an alternative measure of the interest burden: the ratio of interest payments to total debt (*IB2*). We continue to observe that the new interest burden exerts a stronger effect on corporate failures during the financial crisis period than in tranquil periods. The difference in the two coefficients is significant at the 10% level (Table A13). In addition, we find that constrained firms' survival chances are more affected by changes in *IB2* during the crisis compared to more tranquil periods, and that during the crisis, the sensitivity of survival chances to changes in *IB2* is higher for constrained than unconstrained firms (Table A14). We conclude therefore that our main results are robust to using an alternative definition of the interest burden.

11. Description of recent policies aimed at making low cost credit readily available to financially constrained firms in the UK

Under Project Merlin, five major UK banks committed to lend £190 billion in 2011, £76 billion of which were to be targeted at SMEs.

The National Loan Guarantee Scheme, on the other hand, was aimed at enabling SMEs to access lower cost finance through Government guarantees of up to £20bn. Details on these policies can be found on the Department for Business Innovations and Skills website:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32263/12-539-sme-access-external-finance.pdf.

The Funding Lending Scheme, which was introduced in 2012, and extended in 2013, was aimed at boosting loans to corporations by making both the amount and price of funding available to banks conditional on their lending performance. More details can be found at:

http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/qb120401.pdf.

The Discount Window Facility incentivises bank lending by allowing participants to borrow highly liquid gilts from the Bank of England in return for less liquid collateral.

[8] As these tests are not available for IV Probit models, the tests reported in Tables A11 and A12 are those derived from the linear specifications.

Participants can then raise cash by lending the gilts in the market or by using them as collateral to obtain additional funding at a lower rate. More details can be found at: http://www.bankofengland.co.uk/markets/Documents/money/publications/redbookdwf.pdf .

References not included in the paper

Baggs, J., Beaulieu, E. and L. Fung (2009). 'Firm survival, performance, and the exchange rate', *Canadian Journal of Economics,* Vol. 42, pp. 393–421.

Blundell, R., Bond, S., Devereux, M., and F. Schiantarelli (1992). 'Investment and Tobin's Q: Evidence from Company Panel Data.' *Journal of Econometrics,* 51, pp. 233-57.

Chamberlain, G. (1980). 'Analysis of covariance with qualitative data', *Review of Economic Studies,* Vol. 47, pp. 225–238.

Clementi, G. and H. Hopenhayn (2006). 'A theory of financing constraints and firm dynamics', *Quarterly Journal of Economics,* Vol. 1, pp. 229-265.

Disney, R., Haskel, J. and Y. Heden (2003). 'Entry, exit and establishment survival in UK manufacturing', *Journal of Industrial Economics,* Vol. 51, pp. 91-112.

Draca, M., Machin, S., and J. Van Reenen (2011). 'Minimum wages and firm profitability', *American Economic Journal: Applied Economics,* Vol. 3, pp. 129-151.

Eberhardt, M., and C. Helmers (2010). 'Untested assumptions and data slicing: A critical review of firm-level production function estimators', *Mimeograph*, University of Oxford

Faggio, G., Salvanes, K., and J. Van Reenen (2007). 'The evolution of inequality in productivity and wages: Panel data evidence', National Bureau of Economic Research Working Paper No 13351.

Geroski, P. (1995). 'What do we know about entry?' *International Journal of Industrial Organization,* Vol. 13, pp. 421–440.

Mateut, S., Bougheas, S. and P. Mizen (2006). 'Trade credit, bank lending and monetary policy transmission', *European Economic Review,* Vol. 50, pp. 603–629.

Zingales, L. (1998). 'Survival of the fittest or the fattest? Exit and financing in trucking industry', *Journal of Finance,* Vol. 53, pp. 905–938.

TABLE A1: *Structure of the unbalanced panel*

Number of obs. per firm	*Number of firms*	*Percent*	*Cumulative*
1	138	0.68	0.68
2	315	1.56	2.24
3	506	2.50	4.74
4	1,213	5.99	10.73
5	8,522	42.11	52.84
6	176	0.87	53.71
7	337	1.67	55.38
8	649	3.21	58.58
9	1,455	7.19	65.77
10	6,927	34.23	100.00
Total	20,238	100.00	

TABLE A2*: Correlation matrix*

	IB	***Solvency***	***Leverage***	***Profit***	***Size***	***Age***	***Group***	***Exchange***
IB	1.000							
Solvency	-0.323	1.000						
Leverage	0.200	-0.670	1.000					
Profit	-0.532	0.208	-0.138	1.000				
Size	0.045	0.026	-0.118	-0.043	1.000			
Age	-0.030	0.176	-0.165	-0.025	0.197	1.000		
Group	0.044	-0.015	-0.028	-0.001	0.369	0.123	1.000	
Exchange	-0.032	-0.013	0.032	-0.013	-0.044	-0.032	-0.010	1.000

Note: See Section 2 of this Appendix for definitions of all variables.

Table A3: *Summary statistics by industrial group*

	Industry 1	*Industry 2*	*Industry 3*	*Industry 4*	*Industry 5*	*Industry 6*	*Industry 7*	*Industry 8*	*Industry 9*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fail	0.156	0.117	0.112	0.122	0.117	0.127	0.112	0.219	0.15
	(0.36)	(0.32)	(0.32)	(0.33)	(0.32)	(0.33)	(0.32)	(0.41)	(0.35)
IB	0.339	0.354	0.369	0.377	0.359	0.397	0.347	0.397	0.366
	(0.37)	(0.38)	(0.38)	(0.40)	(0.40)	(0.40)	(0.37)	(0.40)	(0.38)
IB2	0.084	0.072	0. 078	0. 085	0.090	0. 075	0.069	0.093	0. 087
	(0.24)	(0.12)	(0.17)	(0.34)	(0.25)	(0.17)	(0.09)	(0.14)	(0.14)
Leverage	0.462	0.396	0.456	0.496	0.483	0.533	0.458	0.468	0.491
	(0.28)	(0.27)	(0.31)	(0.35)	(0.35)	(0.36)	(0.33)	(0.35)	(0.41)
Solvency	0.436	0.483	0.435	0.414	0.432	0.349	0.431	0.442	0.406
	(0.39)	(0.60)	(0.46)	(0.41)	(0.42)	(0.46)	(0.38)	(0.43)	(0.75)
Profit	0.088	0.092	0.080	0.087	0.092	0.064	0.077	0.073	0.089
	(0.17)	(0.28)	(0.18)	(0.18)	(0.22)	(0.18)	(0.14)	(0.16)	(0.21)
Size	3.714	4.159	4.256	3.911	3.888	4.271	4.198	3.682	3.773
	(1.13)	(1.39)	(1.39)	(1.32)	(1.32)	(1.45)	(1.38)	(1.09)	(1.29)
Age	28.279	29.13	26.342	26.278	23.151	21.24	26.568	31.38	25.963
	(22.20)	(23.75)	(22.57)	(22.52)	(18.29)	(19.78)	(24.46)	(26.40)	(22.46)
Group	0.161	0.219	0.230	0.228	0.189	0.209	0.215	0.157	0.180
	(0.36)	(0.41)	(0.42)	(0.42)	(0.39)	(0.41)	(0.41)	(0.36)	(0.38)
Exchange	96.907	96.776	96.68	96.734	96.763	96.78	96.461	97.933	97.143
	(11.49)	(11.54)	(11.54)	(11.52)	(11.55)	(11.52)	(11.54)	(11.37)	(11.50)
Observations	24,233	4,057	17,690	10,735	18,184	5,454	12,150	7,515	37,477

Notes: The table presents sample means. Standard deviations are reported in parentheses. Firms are allocated to one of the following nine industrial groups: (1) food, drink and tobacco; (2) textiles, clothing, leather and footwear; (3) chemicals and man-made fibres; (4) other minerals and mineral products; (5) metal and metal goods; (6) electrical and instrument engineering; (7) motor vehicles and parts, other transport equipment; (8) mechanical engineering; and (9) others. See Section 2 of this Appendix for definitions of all variables.

TABLE A4: *Summary statistics taking firm heterogeneity into account*

	BankDep1=1 (1)	*Bankep1=0* (2)	*Diff.* (3)	*BankDep2=1* (4)	*Bankep2=0* (5)	*Diff.* (6)	*Young=1* (7)	*Young=0* (8)	*Diff.* (9)	*Non-Exporter=1* (10)	*Non-Exporter=0* (11)	*Diff.* (12)
Fail	0.043	0.041	0.286	0.049	0.040	0.000	0.158	0.123	0.000	0.167	0.068	0.000
	(0.19)	(0.20)		(0.21)	(0.19)		(0.36)	(0.33)		(0.37)	(0.25)	
IB	0.420	0.291	0.000	0.437	0.282	0.000	0.390	0.341	0.000	0.346	0.387	0.000
	(0.40)	(0.35)		(0.40)	(0.35)		(0.39)	(0.38)		(0.38)	(0.39)	
Leverage	0.591	0.457	0.000	0.581	0.446	0.000	0.527	0.429	0.000	0.461	0.512	0.000
	(0.37)	(0.22)		(0.43)	(0.23)		(0.37)	(0.32)		(0.35)	(0.34)	
Solvency	0.284	0.405	0.000	0.296	0.421	0.000	0.349	0.488	0.000	0.446	0.362	0.000
	(0.42)	(0.31)		(0.49)	(0.32)		(0.51)	(0.55)		(0.57)	(0.43)	
Profit	0.065	0.091	0.000	0.060	0.097	0.000	0.088	0.083	0.000	0.089	0.078	0.000
	(0.17)	(0.15)		(0.18)	(0.16)		(0.22)	(0.16)		(0.19)	(0.17)	
Size	4.234	3.853	0.000	4.302	3.836	0.000	3.761	4.056	0.000	3.741	4.374	0.000
	(1.34)	(1.16)		(1.41)	(1.19)		(1.34)	(1.27)		(1.29)	(1.25)	
Age	26.992	26.476	0.001	26.985	26.463	0.000	9.966	41.953	0.000	25.172	29.833	0.000
	(22.73)	(21.45)		(23.05)	(21.48)		(5.84)	(21.17)		(22.07)	(22.97)	
Group	0.245	0.177	0.000	0.281	0.178	0.000	0.168	0.215	0.000	0.168	0.264	0.000
	(0.43)	(0.38)		(0.45)	(0.38)		(0.37)	(0.41)		(0.37)	(0.44)	
Exchange	98.528	98.532	0.958	98.368	98.369	0.985	96.984	96.913	0.249	96.694	97.732	0.000
	(11.03)	(11.03)		(11.02)	(11.02)		(11.46)	(11.56)		(11.66)	(10.99)	
Observations	38,142	38,095		42,276	42,235		66,983	69,999		103,481	33,501	

Notes: The table presents sample means. Standard deviations are reported in parentheses. *BankDep1* (*BankDep2*) is equal to 1 for firm *i* in year *t* if this firm's *mix1* (*mix2*) is in the top 50% of the distribution of the *mix1*s (*mix2s*) of all firms operating in the same industry as firm *i* in year *t*, and 0 otherwise. *Mix1* is the ratio of short-term debt to the sum of short-term debt and trade credit. *Mix2* is the ratio of short-term debt to total current liabilities. *Young* is equal to 1 in a given year for firms in the bottom 50% of the age distribution of all firms operating in the same industry as firm *i* in that year, and 0 otherwise. *Non-exporter* is a dummy variable equal to 1 if the firm has never reported a positive amount of exports throughout the sample period, and 0 otherwise. *Diff.* is the *p*-value of the test statistic for the equality of means. See Section 2 of this Appendix for definitions of all variables.

Table A5: *Firm survival and the financial crisis: including IB lagged*

Fail	Baseline
	(1)
IB_{t-1}	0.536***
	(7.07)
$Solvency_t$	-0.293*
	(-1.84)
$Leverage_t$	0.498***
	(3.25)
$Profit_t$	-0.563***
	(-2.88)
$Size_t$	-0.405***
	(-14.35)
Age_t	0.000
	(0.26)
$Group_t$	-0.487***
	(-5.42)
$Exchange_t$	0.193***
	(4.85)
Observations	41,690
Log-Likelihood	-5044

Notes: A proportional hazard model was used in estimation. The dependent variable is a dummy equal to 1 if the firm fails, and 0 otherwise. Robust z-statistics are presented in parentheses. Standard errors are clustered at the firm level. Time and industry dummies were included in all models. See Section 2 of this Appendix for definitions of all variables. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

TABLE A6: *Fixed-effects models*

Fail	***FE***	***Logit-FE***
	(1)	(3)
IB	0.003**	0.543**
	(2.04)	(2.33)
Solvency	-0.012***	-0.220
	(-2.91)	(-0.30)
Leverage	-0.006	-0.694
	(-1.40)	(-0.94)
Profit	0.014***	-2.207***
	(3.61)	(-3.20)
Size	-0.008***	-0.216
	(-5.57)	(-0.93)
Age	0.005***	0.001
	(30.28)	(0.70)
Group	-0.025***	-1.913***
	(-9.04)	(-4.31)
Exchange	0.004***	0.367***
	(15.63)	(12.29)
Observations	58,995	1,690
R-squared	0.837	
Log-likelihood		365.9

Notes: Fixed-effects (FE) and conditional fixed-effects logit estimates are reported. The dependent variable is a dummy equal to 1 in a given year if the firm is recorded as failed in that year, and 0 otherwise. Robust z-statistics are presented in parentheses. Time dummies were included in all models. See Section 2 of this Appendix for definitions of all variables. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

TABLE A7: *Dealing with fixed-effects and controlling for endogeneity*

Fail	***Fixed-effects IV***	***2SLS FD***
	(1)	(2)
IB	0.019**	0.015**
	(2.20)	(2.88)
Solvency	-0.028	-0.155
	(-1.47)	(-1.63)
Leverage	0.007	0.044
	(0.35)	(0.80)
Profit	0.234**	0.306**
	(2.19)	(2.43)
Size	-0.007	-0.107**
	(-1.33)	(-2.37)
Age	0.048	-
	(0.64)	
Group	-0.027***	-0.017**
	(-6.53)	(-2.44)
Exchange	0.005	0.0005
	(0.62)	(1.17)
Observations	23,798	15,365
Sargan (p-value)	0.559	0.053
Anderson (p-value)	0.000	0.000
Cragg-Donald Wald test (p-value)	0.000	0.000

Notes: The dependent variable is a dummy equal to 1 in a given year if the firm is recorded as failed in that year, and 0 otherwise. Column 1 reports fixed-effects estimates where all financial variables are treated as endogenous. Column 2 reports two stage least squares (2SLS) estimates of the model estimated in first-differences (FD). As in column 1, all financial variables are treated as endogenous. In both columns, *IB* is instrumented using the Bank of England base interest rate and the ten year government bond yield; and leverage, solvency and profit, using their own lags. Robust z-statistics are presented in parentheses. The Sargan statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. The Anderson canonical correlation statistic and the Cragg-Donaldson Wald statistic are distributed as chi-square under the null that the equation is unidentified. Time dummies were included in all models. See Section 2 of this Appendix for definitions of all variables. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

TABLE A8: *Pooled IV models for firm survival and the financial crisis*

Fail	***Baseline*** (1)	***IB and Crisis*** (2)	***IB*Crisis*** (3)
IB	0.035***	0.035***	
	(3.22)	(3.22)	
Crisis		-0.016	0.004
		(-1.05)	(0.51)
IB*Crisis			0.076***
			(4.12)
IB*(1-Crisis)			0.005
			(0.49)
Solvency	0.005	0.005	0.006
	(0.51)	(0.51)	(0.63)
Leverage	0.032***	0.032***	0.030***
	(3.43)	(3.43)	(3.17)
Profit	-0.055*	-0.055*	-0.057**
	(-1.80)	(-1.80)	(-1.93)
Size	-0.011***	-0.011***	-0.010***
	(-8.66)	(-8.66)	(-8.48)
Age	0.001	0.001	0.001
	(0.80)	(0.80)	(0.78)
Group	-0.006**	-0.006**	-0.006**
	(-2.40)	(-2.40)	(-2.46)
Exchange	0.001***	0.001***	0.001***
	(5.52)	(5.52)	(6.35)
F-test of equality (p-value) for IB			0.000
Observations	26,500	26,500	26,500
Sargan (p-value)	0.529	0.603	0.100
Anderson (p-value)	0.000	0.000	0.000
Wald (p-value)	0.000	0.000	0.000
Kleibergen-Paap (p-value)	0.000	0.000	0.000

Notes: The dependent variable is a dummy equal to 1 in a given year if the firm is recorded as failed in that year, and 0 otherwise. Robust z-statistics are presented in parentheses. *IB* is instrumented using the Bank of England base interest rate and the ten year government bond yield; and leverage, solvency and profit, using their own lags. The *F*-test of equality for *IB* refers to the test of equality between *IB*Crisis* and *IB*(1-Crisis)*. Time and industry dummies were included in all models. The Sargan statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. The Anderson canonical correlation statistic and the Kleibergen-Paap statistic are distributed as chi-square under the null that the equation is unidentified. The Wald statistic is distributed as chi-square under the null of exogeneity. See Section 2 of this Appendix for definitions of all variables. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

TABLE A9: *First stage results for the pooled IV regression reported in column 1 of Table A8*

	IB	***Solvency***	***Leverage***	***Profit***
Base rate	0.009***	-0.003***	0.002***	0.003***
	(0.002)	(0.001)	(0.001)	(0.001)
Bond yield	0.017	0.012**	0.008	-0.004
	(0.014)	(0.005)	(0.005)	(0.005)
Solvency $_{(t-1)}$	-0.305***	0.083***	-0.044***	0.0021***
	(0.012)	(0.004)	(0.005)	(0.004)
Leverage $_{(t-2)}$	0.029*	-0.029***	0.058***	-0.018***
	(0.017)	(0.006)	(0.006)	(0.006)
Profit $_{(t-1)}$	-0.079***	0.058***	-0.044***	0.371***
	(0.019)	(0.007)	(0.007)	(0.007)
Observations	26500	26500	26500	26500
F-stat	648	8470	7298	415

Notes: The Table presents the coefficients and standard errors. It should be noted that in the first-stage regression, all endogenous variables are regressed on the instruments and all control variables, time dummies, and industry dummies. We do not report the coefficients associated with the control variables and the dummies for brevity. See Section 2 of this Appendix for definitions of all variables. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

TABLE A10: *Pooled IV models for firm survival, financing constraints, and the crisis*

Fail	***Cons= f(BankDep1)*** (1)	***Cons= f(BankDep2)*** (2)	***Cons= f(Young)*** (3)	***Cons= f (Non-Exporter)*** (4)
IB*Cons* Crisis	0.046***	0.031**	0.058***	0.046**
	(2.85)	(2.12)	(2.95)	(2.93)
IB*Cons*(1-Crisis)	-0.007	0.034**	0.021	-0.016
	(-0.48)	(2.02)	(1.42)	(-1.04)
IB*(1-Cons)* Crisis	0.019*	0.048**	0.018	0.017
	(1.76)	(1.97)	(1.42)	(1.43)
IB*(1-Cons)*(1-Crisis)	-0.014	0.084***	-0.019	0.013
	(-1.13)	(2.60)	(-1.58)	(.67)
Crisis	-0.011	-0.012	-0.023	-0.018
	(-0.95)	(-1.10)	(-0.95)	(-1.21)
Solvency	-0.005	0.017	-0.006	-0.008
	(0.52)	(1.52)	(-0.66)	(0.81)
Leverage	0.029***	0.041***	0.025**	0.023***
	(3.23)	(3.65)	(2.35)	(2.65)
Profit	-0.065*	-0.037	-0.071**	-0.074**
	(-1.86)	(-1.02)	(-2.03)	(-2.14)
Size	-0.009***	-0.008***	-0.010***	-0.010***
	(-10.13)	(-7.22)	(-8.75)	(-9.03)
Age	0.001	0.001	0.0001*	0.0001
	(1.04)	(0.78)	(1.92)	(0.63)
Group	-0.006***	-0.006**	-0.006**	-0.006**
	(-2.60)	(-2.27)	(-2.26)	(-2.30)
Exchange	0.001**	0.001***	0.001***	0.001***
	(2.29)	(4.31)	(5.70)	(5.78)
F-test of equality (p-value)				
IB*Cons	0.000	0.887	0.051	0.004
IB*(1-Cons)	0.028	0.356	0.028	0.841
IB*Crisis	0.037	0.535	0.026	0.083
IB*(1-Crisis)	0.698	0.124	0.027	0.891
Observations	24,027	24,528	26,500	26,500
Sargan (*p*-value)	0.540	0.484	0.514	0.726
Anderson (*p*-value)	0.000	0.000	0.000	0.000
Wald (*p*-value)	0.017	0.006	0.001	0.000
Kleibergen-Paap (p-value)	0.000	0.000	0.000	0.000

Notes: The dependent variable is a dummy equal to 1 in a given year if the firm is recorded as failed in that year, and 0 otherwise. *Cons* is a dummy variable equal to 1 if the firm is financially constrained, and 0 otherwise. It is based, in turn, on *BankDep(1/2)*, *Young*, and *Non-exporter*. *BankDep1(2)* is equal to 1 in a given year for firm *i* if its *mix1(2)* is in the top 50% of the distribution of the *mix1(2)*s of all firms operating in the same industry as firm *i* in that year, and 0 otherwise. *Mix1* is the ratio of short-term-debt to the sum of short- term debt and trade credit. *Mix2* is the ratio of short-term debt to total current liabilities. *Young* is equal to 1 for firm *i* in year *t* if this firm's age falls in the lower 50% of the age distribution of all firms operating in the same industry as firm *i* in that year, and 0 otherwise. *Non-exporter* is a dummy variable equal to 1 if the firm has never reported a positive amount of exports throughout the sample period, and 0 otherwise. *IB* is instrumented using the Bank of England base interest rate and the ten year government bond yield; and leverage, solvency and profit, using their own lags. Time and industry dummies were included in all models. With reference to the *F*-test of equality, *IB*Cons* refers to the test of equality between *IB*Cons*Crisis* and *IB*Cons*(1-Crisis)*. *IB*(1-Cons)* refers to the test of equality between *IB*(1-Cons)*Crisis* and *IB*(1-Cons)*(1-Crisis)*. *IB*Crisis* refers to the test of equality between *IB*Cons*Crisis* and *IB*(1-Cons)*Crisis*. Finally, *IB*(1-Crisis)* refers to the test of equality between *IB*Cons*(1-Crisis)* and *IB*(1-Cons)*(1-Crisis)*. The Sargan statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. The Anderson canonical correlation statistic and the Kleibergen-Paap statistic are distributed as chi-square under the null that the equation is unidentified. The Wald statistic is distributed as chi-square under the null of exogeneity. See Section 2 of this Appendix for definitions of all variables. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

TABLE A11: *Probit IV models for firm survival and the financial crisis*

Fail	***Baseline*** (1)	***IB and Crisis*** (2)	***IB*Crisis*** (3)
IB	0.664***	0.635**	
	(2.66)	(2.54)	
Crisis		-0.083	0.346
		(-1.19)	(0.85)
IB*Crisis			0.735**
			(2.47)
IB*(1-Crisis)			-0.140
			(-1.29)
Solvency	0.026	0.006	-0.102
	(0.16)	(0.03)	(-0.66)
Leverage	0.505***	0.472**	0.499***
	(3.36)	(2.46)	(3.29)
Profit	-1.030**	-1.139**	-1.117**
	(-2.14)	(-2.41)	(-2.34)
Size	-0.243***	-0.241***	-0.247***
	(-11.65)	(-11.53)	(-11.79)
Age	0.001	0.001	0.001
	(1.23)	(1.12)	(1.31)
Group	-0.169***	-0.169***	-0.158***
	(-3.08)	(-3.09)	(-2.89)
Exchange	0.043***	0.042***	0.044***
	(11.29)	(10.38)	(10.61)
F-test of equality (p-value) for IB			0.005
Observations	26,500	26,500	26,500
Sargan (p-value)	0.529	0.603	0.100
Anderson (p-value)	0.000	0.000	0.000
Wald (p-value)	0.000	0.000	0.000
Kleibergen-Paap (p-value)	0.000	0.000	0.000

Notes: Two-step IV probit estimates are reported. The dependent variable is a dummy equal to 1 in a given year if the firm is recorded as failed in that year, and 0 otherwise. Time and industry dummies were included in all models. Robust z-statistics are presented in parentheses. *IB* is instrumented using the Bank of England base interest rate and the ten year government bond yield; and leverage, solvency and profit, using their own lags. The *F*-test of equality for *IB* refers to the test of equality between *IB*Crisis* and *IB*(1-Crisis)*. The Sargan statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. The Anderson canonical correlation statistic and the Kleibergen-Paap statistic are distributed as chi-square under the null that the equation is unidentified. The Wald statistic is distributed as chi-square under the null of exogeneity. See Section 2 of this Appendix for definitions of all variables. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

TABLE A12: *Probit IV models for firm survival, financing constraints, and the crisis*

Fail	***Cons= f(BankDep1)***	***Cons= f(BankDep2)***	***Cons= f(Young)***	***Cons= f (Non-Exporter)***
	(1)	(2)	(3)	(4)
IB*Cons* Crisis	1.513***	1.298***	0.934***	0.993***
	(2.89)	(2.74)	(2.87)	(2.90)
IB*Cons*(1-Crisis)	-0.115	0.104	0.035	-0.104
	(-0.43)	(0.41)	(0.15)	(-0.47)
IB*(1-Cons)* Crisis	0.656**	0.619**	0.461**	0.763***
	(2.02)	(2.12)	(2.03)	(2.73)
IB*(1-Cons)*(1-Crisis)	-0.215	0.318	-0.282	0.317
	(-0.87)	(0.76)	(-1.39)	(1.18)
Crisis	-0.274	-0.216	-0.338	-0.388
	(-0.64)	(-0.67)	(-0.35)	(-0.67)
Solvency	0.116	0.178	-0.067	0.071
	(0.55)	(0.90)	(-0.41)	(0.39)
Leverage	0.692***	0.704***	0.506***	0.558***
	(3.76)	(4.00)	(3.31)	(3.52)
Profit	-0.917	-1.114*	-1.241**	-0.775
	(-1.33)	(-1.79)	(-2.10)	(-1.26)
Size	-0.243***	-0.236***	-0.249***	-0.255***
	(-10.57)	(-10.28)	(-11.85)	(-11.97)
Age	0.001	0.001	0.002*	0.001
	(1.40)	(1.29)	(1.95)	(1.23)
Group	-0.150***	-0.150***	-0.158***	-0.164***
	(-2.64)	(-2.71)	(-2.85)	(-2.99)
Exchange	0.046***	0.046***	0.043***	0.043***
	(10.35)	(10.31)	(10.06)	(10.18)
F-test of equality (p-value)				
IB*Cons	0.000	0.028	0.005	0.000
IB*(1-Cons)	0.000	0.563	0.000	0.147
IB*Crisis	0.004	0.019	0.247	0.186
IB*(1-Crisis)	0.604	0.527	0.097	0.028
Observations	24,027	24,528	26,500	26,500
Sargan (*p*-value)	0.540	0.484	0.514	0.726
Anderson (*p*-value)	0.000	0.000	0.000	0.000
Wald (*p*-value)	0.017	0.006	0.001	0.000
Kleibergen-Paap (p-value)	0.000	0.000	0.000	0.000

Notes: Two-step IV probit estimates are reported. The dependent variable is a dummy equal to 1 in a given year if the firm is recorded as failed in that year, and 0 otherwise. Time and industry dummies were included in all models. Robust z-statistics are presented in parentheses. *Cons* is a dummy variable equal to 1 if the firm is financially constrained, and 0 otherwise. It is based, in turn, on *BankDep(1/2)*, *Young*, and *Non-exporter*. *BankDep1(2)* is equal to 1 in a given year for firm *i* if its *mix1(2)* is in the top 50% of the distribution of the *mix1(2)*s of all firms operating in the same industry as firm *i* in that year, and 0 otherwise. *Mix1* is the ratio of short-term- debt to the sum of short- term debt and trade credit. *Mix2* is the ratio of short-term debt to total current liabilities. *Young* is equal to 1 for firm *i* in year *t* if this firm's age falls in the lower 50% of the age distribution of all firms operating in the same industry as firm *i* in that year, and 0 otherwise. *Non-exporter* is a dummy variable equal to 1 if the firm has never reported a positive amount of exports throughout the sample period, and 0 otherwise. *IB* is instrumented using the Bank of England base interest rate and the ten year government bond yield; and leverage, solvency and profit, using their own lags. With reference to the *F*-test of equality, *IB*Cons* refers to the test of equality between *IB*Cons*Crisis* and *IB*Cons*(1-Crisis)*. *IB*(1-Cons)* refers to the test of equality between *IB*(1-Cons)*Crisis* and *IB*(1-Cons)*(1-Crisis)*. *IB*Crisis* refers to the test of equality between *IB*Cons*Crisis* and *IB*(1-Cons)*Crisis*. Finally, *IB*(1-Crisis)* refers to the test of equality between *IB*Cons*(1-Crisis)* and *IB*(1-Cons)*(1-Crisis)*. The Sargan statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. The Anderson canonical correlation statistic and the Kleibergen-Paap statistic are distributed as chi-square under the null that the equation is unidentified. The Wald statistic is distributed as chi-square under the null of exogeneity. See Section 2 of this Appendix for definitions of all variables. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

TABLE A13: *Firm survival and the crisis: Alternative interest burden*

Fail	***Baseline*** (1)	***IB2 and Crisis*** (2)	***IB2*Crisis*** (3)
IB2	0.253***	0.253***	
	(4.95)	(4.95)	
Crisis		1.012*	1.046*
		(1.73)	(1.77)
IB2*Crisis			0.360***
			(5.21)
IB2*(1-Crisis)			0.207***
			(3.63)
Solvency	-0.420***	-0.420***	-0.435***
	(-3.05)	(-3.05)	(-3.17)
Leverage	1.065***	1.065***	1.048***
	(7.58)	(7.58)	(7.49)
Profit	-1.017***	-1.017***	-1.019***
	(-5.87)	(-5.87)	(-5.88)
Size	-0.331***	-0.331***	-0.330***
	(-13.46)	(-13.46)	(-13.43)
Age	0.001	0.001	0.001
	(0.76)	(0.76)	(0.72)
Group	-0.499***	-0.499***	-0.501***
	(-6.24)	(-6.24)	(-6.25)
Exchange	0.167***	0.167***	0.171***
	(4.41)	(4.41)	(4.43)
Constant	-16.807***	-17.819***	-18.165***
	(-5.41)	(-4.85)	(-4.86)
F-test of equality (p-value) for IB2			0.087
Observations	36,330	36,330	36,330
Log-Likelihood	-5,886	-5,886	-5,885

Notes: All estimates were obtained using a proportional hazard model. The dependent variable is a dummy equal to 1 in a given year if the firm is recorded as failed in that year, and 0 otherwise. *IB2* is the ratio of interest payments to total debt. Robust z-statistics are presented in parentheses. The *F*-test of equality for *IB2* refers to the test of equality between *IB2*Crisis and IB2*(1-Crisis)*. Time and industry dummies were included in all models. See Section 2 of this Appendix for definitions of all variables. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

TABLE A14: *Firm survival, financing constraints, and the crisis: Alternative interest burden*

Fail	***Cons= f(BankDep1)***	***Cons= f(BankDep2)***	***Cons= f(Young)***	***Cons= f(Non-Exporter)***
	(1)	(2)	(3)	(4)
IB2*Cons* Crisis	2.382***	6.721***	0.704***	0.945***
	(5.34)	(9.46)	(5.06)	(5.78)
IB2*Cons*(1-Crisis)	1.391**	3.171***	0.215***	0.120
	(2.41)	(5.84)	(3.32)	(1.57)
IB2*(1-Cons)* Crisis	0.351***	0.373***	0.305***	0.315***
	(4.89)	(5.26)	(4.01)	(4.11)
IB2*(1-Cons)*(1-Crisis)	0.210***	0.210***	0.164	0.392***
	(3.66)	(3.65)	(1.31)	(3.87)
Crisis	1.069*	1.056*	0.965	1.006*
	(1.73)	(1.71)	(1.64)	(1.72)
Solvency	-0.410***	-0.372***	-0.441***	-0.458***
	(-2.92)	(-2.70)	(-3.20)	(-3.35)
Leverage	1.084***	1.067***	1.046***	1.034***
	(7.58)	(7.54)	(7.44)	(7.40)
Profit	-1.069***	-1.032***	-1.012***	-1.010***
	(-6.17)	(-6.04)	(-5.84)	(-5.83)
Size	-0.335***	-0.338***	-0.330***	-0.330***
	(-13.54)	(-13.76)	(-13.41)	(-13.40)
Age	0.001	0.001	0.001	0.001
	(0.86)	(0.49)	(0.92)	(0.73)
Group	-0.510***	-0.510***	-0.503***	-0.505***
	(-6.24)	(-6.34)	(-6.27)	(-6.30)
Exchange	0.177***	0.181***	0.168***	0.172***
	(4.38)	(4.38)	(4.39)	(4.50)
Constant	-18.735***	-19.136***	-17.822***	-18.188***
	(-4.80)	(-4.80)	(-4.83)	(-4.94)
F-test of equality (p-value)				
IB2*Cons	0.172	0.000	0.001	0.000
IB2*(1-Cons)	0.125	0.073	0.335	0.538
IB2*Crisis	0.000	0.000	0.011	0.000
IB2*(1-Crisis)	0.040	0.000	0.717	0.031
Observations	35,428	36,330	36,330	36,330
Log-Likelihood	-5755	-5854	-5883	-5880

Notes: All estimates were obtained using a proportional hazard model. The dependent variable is a dummy equal to 1 in a given year if the firm is recorded as failed in that year, and 0 otherwise. *IB2* is the ratio of interest payments to total debt. Robust z-statistics are presented in parentheses. *Cons* is a dummy variable equal to 1 if the firm is financially constrained, and 0 otherwise. It is based, in turn, on *BankDep(1/2)*, *Young*, and *Non-exporter*. *BankDep1(2)* is equal to 1 in a given year for firm *i* if its *mix1(2)* is in the top 50% of the distribution of the *mix1(2)*s of all firms operating in the same industry as firm *i* in that year, and 0 otherwise. *Mix1* is the ratio of short-term- debt to the sum of short- term debt and trade credit. *Mix2* is the ratio of short-term debt to total current liabilities. *Young* is equal to 1 for firm *i* in year *t* if this firm's age falls in the lower 50% of the age distribution of all firms operating in the same industry as firm *i* in that year, and 0 otherwise. *Non-exporter* is a dummy variable equal to 1 if the firm has never reported a positive amount of exports throughout the sample period, and 0 otherwise. Time and industry dummies were included in all models. With reference to the *F*-test of equality, *IB2*Cons* refers to the test of equality between *IB2*Cons*Crisis* and *IB2*Cons*(1-Crisis)*. *IB2*(1-Cons)* refers to the test of equality between *IB2*(1-Cons)*Crisis* and *IB2*(1-Cons)*(1-Crisis)*. *IB2*Crisis* refers to the test of equality between *IB2*Cons*Crisis* and *IB2*(1-Cons)*Crisis*. Finally, *IB2*(1-Crisis)* refers to the test of equality between *IB2*Cons*(1-Crisis)* and *IB2*(1-Cons)*(1-Crisis)*. See Section 2 of this Appendix for definitions of all variables. *: significant at 10%; **: significant at 5%; ***: significant at 1%.

Figures comparing the average percentage change of profitability and the average failure rates in our sample and in the ONS database

Figure A1: Comparing the average percentage change of profitability

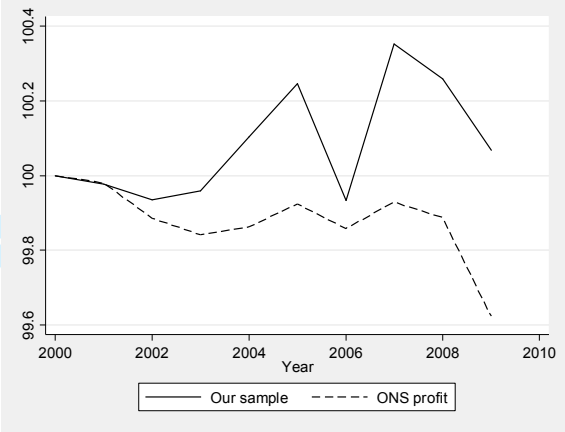
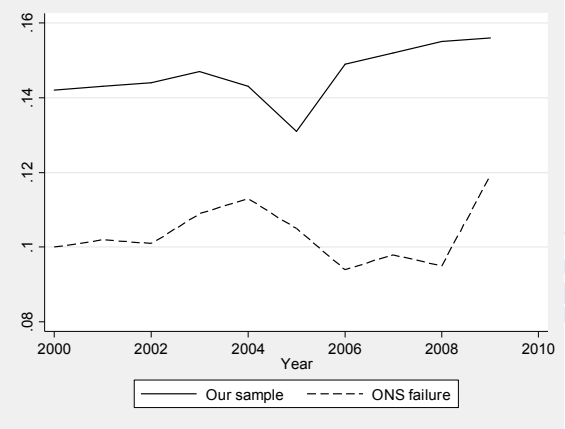


Figure A2: Comparing the average failure rates



Figures comparing the evolution over time of the failure rate, the debt ratio, and the solvency ratio for our full sample and those firms which were dropped in estimation

Figure A3: Comparing the failure rate

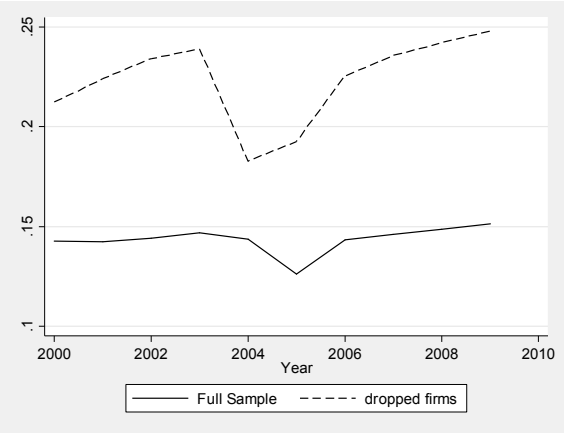


Figure A4: Comparing the debt ratio

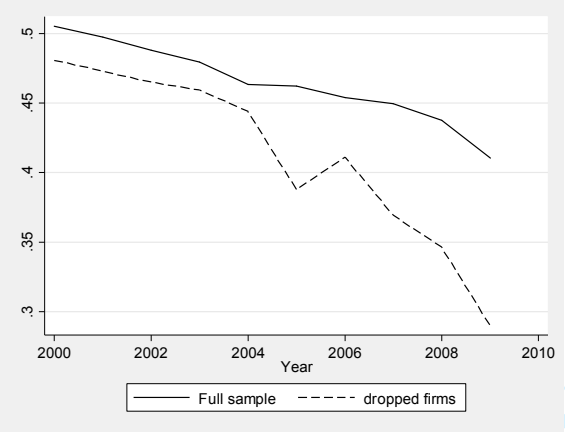
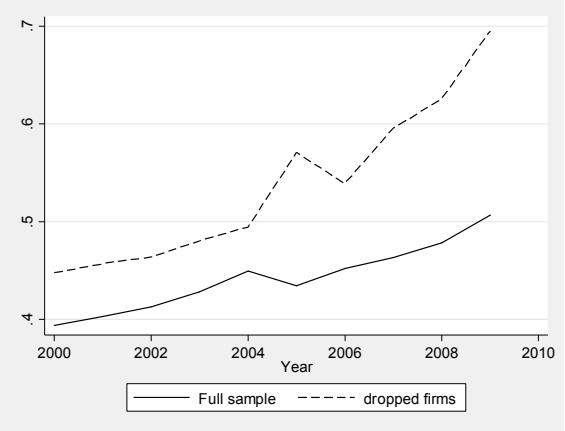


Figure A5: Comparing the solvency ratio



Figures providing a comparison of failure rates in our sample with those of the entire FAME dataset for various categories of firms

Figure A6: Comparison for the full sample

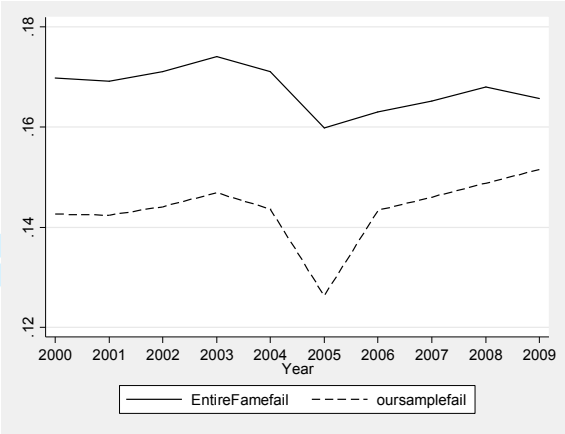


Figure A7: Comparison for young and old firms

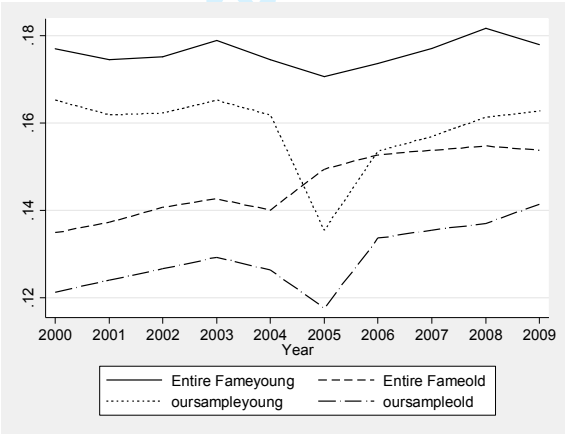


Figure A8: Comparison for small and large firms

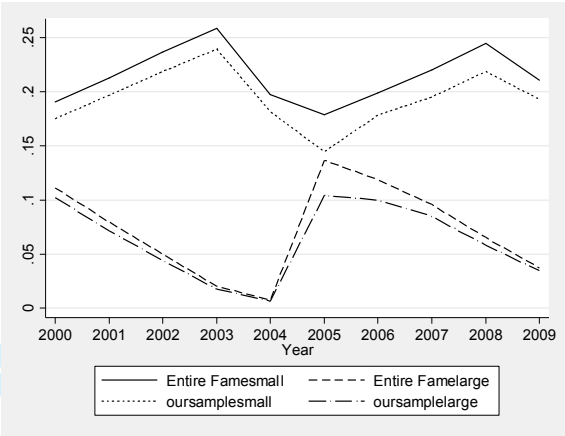


Figure A9: Comparison for firms belonging to different industrial groups (1)

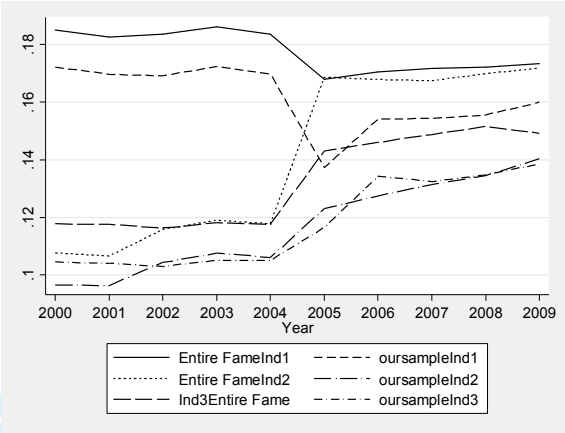


Figure A10: Comparison for firms belonging to different industrial groups (2)

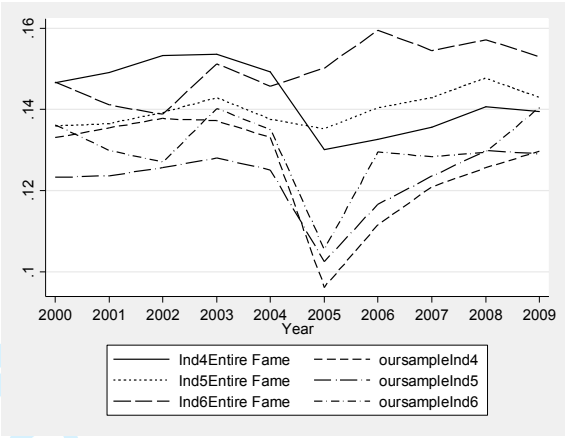


Figure A11: Comparison for firms belonging to different industrial groups (3)

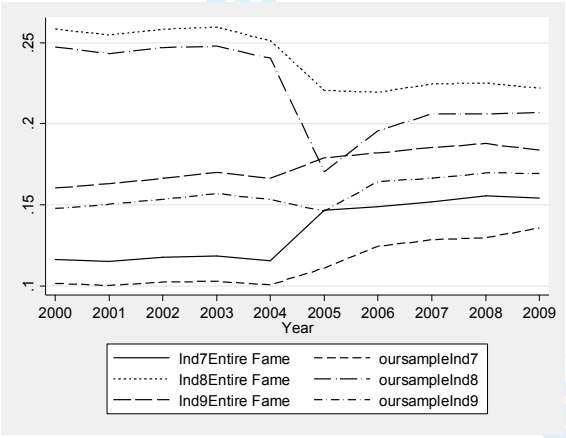


Figure showing the failure rates for firm-years that experienced a rise in the interest burden (H.IB) versus firm-years whose interest burden either stayed constant or declined (L.IB)

Figure A12: Comparing the failure rates of H.IB and L.IB firm-years